Model 2001
Pulse Oximeter

User's Manual

May11, 2000

Catalog No. 9400-23-01

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Section 1 *Introduction*

This manual describes the use and operation of the *Model 2001* Pulse Oximeter Monitor from Novametrix Medical Systems Inc.

Model 2001 is a lightweight, easy to use, pulse oximeter designed to be used in a variety of clinical settings. It provides reliable measurement, display and alerts for functional pulsatile oxygen saturation (SpO_2) and pulse rate. The monitor can be powered from the AC Mains (line voltage) or from its rechargeable internal battery.

Numerical and waveform information is presented on a bright Cold Cathode Display (CCD) with user adjustable contrast to optimize viewing angles. A simple menu system allows user selection of measurement and display options. Alerts are menu programmable or automatic. Numerical and plethysmogram displays are continually updated. Presence of a pulse is indicated audibly by a user selectable "beep".

Separate 24 hour trends for SpO_2 and pulse rate are updated every 8 seconds. In addition, trend "events" and audible alarm status (Audio Off) are stored in trend memory.

The monitor is equipped with an RS232 serial output port for easy interfacing to external equipment. An optional Analog Output module provides analog outputs.

Per requirements of IEC 601-1, the Model 2001 is classified as class II equipment, with type BF applied part, and an enclosure protection rating of IPX0. The Model 2001 is Year 2000 compliant.

SpO_2 Principles of Operation

Model 2001 measures oxygen saturation and pulse rate with sensors that contain red and infrared light sources, called LEDs. Since oxygen saturated blood absorbs different amounts of light at each wavelength (red and infrared) as compared to unsaturated blood, the amount of light absorbed by the blood in each pulse can be used to calculate oxygen saturation.

The light energy from red (660 nm) and infrared (940 nm) LEDs is beamed through a sample cell, such as a pulsating vascular bed—the patient's finger or toe, for example. The remaining light energy not absorbed by the sample cell reaches a light receptor, called a photodiode, on the opposing side of the sensor. The data received at the photodiode is sent back to the monitor where it is split into its red and infrared components, digitized, processed by a microprocessor chip, and finally displayed as a numerical value for oxygen saturation and a plethysmogram.

Model 2001 is calibrated to display "functional" saturation. This differs from the "fractional" saturation value displayed by most co-oximeters.

Equation 1. Functional Saturation Calculation

$$\text{Functional Saturation} = \frac{HbO_2}{100 - (COHb + METHb)}$$

HbO_2 = Fractional Hemoglobin
COHb = Carboxyhemoglobin
METHb = Methemoglobin

Functional saturation represents the amount of oxyhemoglobin as a percentage of the hemoglobin that can be oxygenated. Dysfunctional hemoglobins (COHb and METHb) are not included in the measurement of functional saturation.

Pulse Rate is calculated by measuring the time interval between the peaks of the infrared light waveform. The inverse of this measurement is displayed as pulse rate.

Model 2001 must be used in conjunction with SuperBright™ saturation sensors. (An INSUFFICIENT LIGHT display message indicates a non-SuperBright™ Sensor may be in use.)

Indications and Usage

The *Model 2001* Pulse Oximeter Monitor is intended to be used for monitoring oxygen saturation and pulse rate in all critical monitoring environments including ventilatory support and anesthesia. *Model 2001* is designed to monitor all patient areas including adult, pediatric and neonatal.

Symbols

Symbol	Description
	Patient Isolation Identifies patient isolation connection as type BF.
	Attention Consult manual for detailed information.
	Indicates heavy metal content, specifically lead. Found on the internal battery and monitor enclosure. Refer to qualified service personnel when battery replacement is required.
	Recyclable item Found on the internal battery. Refer to qualified service personnel when battery replacement is required.
Pb	**Separate collection** Ensure that spent batteries are collected separately when disposed of. Found on the internal battery. Refer to qualified service personnel when battery replacement is required.

Section 2 Patient Safety

The SpO_2 input for the *Model 2001* Pulse Oximeter is electrically isolated. Patient leakage current flowing from the instrument to ground is limited to less than 25 µA at 120 VAC, 60 Hz. Patient isolation is greater than 10 MΩ, 4000 VAC rms at 60 Hz. The Model 2001 is Year 2000 compliant.

For maximum patient and operator safety, the following are recommended:

- **Failure of Operation:** If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- Keep *Model 2001* and its accessories clean.
- Do not operate *Model 2001* when it is wet due to spills or condensation.
- Do not operate *Model 2001* if it appears to have been dropped or damaged.
- Connect the line cord only to a grounded hospital-grade outlet. *Model 2001* should be connected to the same electrical circuit as other equipment in use on the patient. Outlets on the same circuit can be identified by the hospital's engineering department.
- Care should be exercised to assure continued peripheral perfusion distal to the SpO_2 sensor site after application.
- Components of this product and its associated accessories which may have patient contact are free of latex.
- The *Model 2001* contains no user serviceable parts. Refer servicing to qualified service personnel. A technical Service Manual (Catalog No. 9400-90) is available for use by technical personnel.

Warnings

WARNING

Indicates a potentially harmful condition that can lead to personal injury

- **Explosion Hazard:** Do NOT use *Model 2001* in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- **Electrical Shock Hazard:** Always turn *Model 2001* off and remove line cord before cleaning it. Do NOT use a damaged sensor or one with exposed electrical contacts. Refer servicing to qualified service personnel.
- Do not operate *Model 2001* when it is wet due to spills or condensation.
- Do not operate *Model 2001* if it appears to have been dropped or damaged.
- **Patient Safety:** Extreme care should be exercised with neonates to assure continued circulation distal to the sensor site after application.
- **Failure of Operation:** If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- **Patient Safety:** Care should be exercised to assure continued peripheral perfusion distal to the SpO_2 sensor site after application.
- **Data Validity:** As with all pulse oximeters, inaccurate SpO_2 and Pulse Rate values may be caused by:

  - Incorrect application or use of a sensor
  - Significant levels of dysfunctional hemoglobin such as carboxyhemoglobin or methemoglobin
  - Significant levels of indocyanine green, methylene blue, or other intravascular dyes
  - Exposure to excessive illumination such as surgical lamps—especially ones with a xenon light source, or direct sunlight
  - Excessive patient movement.
  - Venous pulsations.
  - Electrosurgical interference
- **Data Validity:** The Pulse Oximeter should not be used as a substitute for an ECG monitor. The oximeter's Pulse Rate display reflects the pulsatile flow found at the patient extremity connected to the sensor. This rate can be affected by many factors and may occasionally be "frozen."
- **Do *NOT*** attach an SpO_2 sensor distal to a blood pressure cuff. Valid data *CANNOT* be processed when the cuff is inflated. Attach the sensor to the limb opposite to the site used for the blood pressure cuff.
- **Do *NOT*** apply Y-Sensor tapes or wraps so tightly that the circulation is restricted. Inspect site often for adequate circulation - at least once every four hours. When applying sensors take note of the patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.
- Do not position the sensor cable in any manner that may cause entanglement or strangulation.
- The *Model 2001* has no protection against the ingress of water.

Cautions

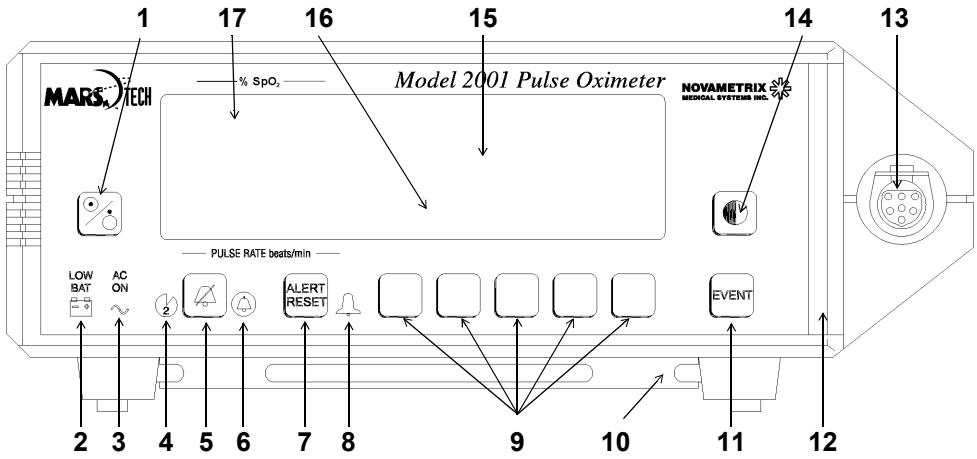
CAUTION

Indicates a condition that may lead to equipment damage or malfunction.

- Do not operate *Model 2001* when it is wet due to spills or condensation.
- Do not operate *Model 2001* if it appears to have been dropped or damaged.
- Never sterilize or immerse the monitor in liquids.
- Do not sterilize or immerse sensors except as directed in this manual.
- No tension should be applied to any sensor cable.
- Overstretching the pulse oximeter finger sensor can damage the sensor and potentially affect pulse oximeter readings. Do not stretch the finger sensor open beyond the limit for which it was designed. Overstretching can be prevented: avoid opening the sensor by any means other than squeezing the grips; Do *NOT* force the sensor onto large objects such as the bed rail.
- Do not store the monitor or sensors at temperatures less than 14° F (-10° C) or greater than 131° F (55° C), 10-95% R.H. non-condensing.
- Do not operate the monitor or sensors at temperatures less than 50° F (10° C) or greater than 104° F (40° C), 0-90% R.H. non-condensing.
- Where electromagnetic devices (i.e. electrocautery) are used, patient monitoring may be interrupted due to electromagnetic interference. Electromagnetic fields up to 3V/m will not adversely affect system performance.
- Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

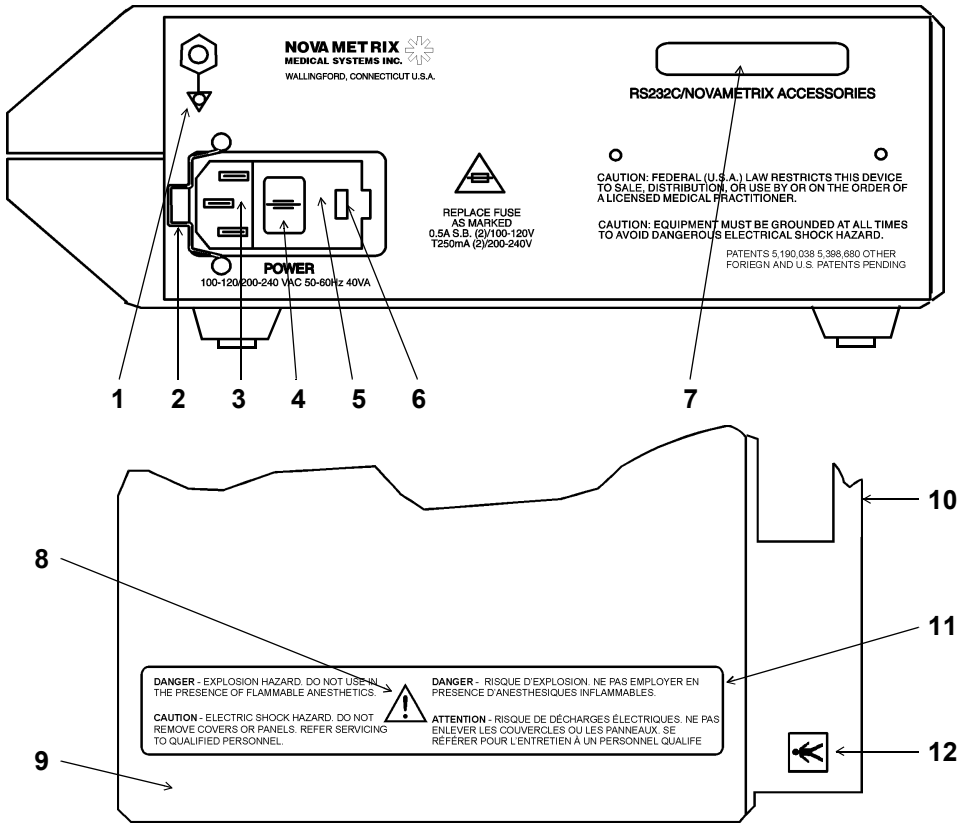
Section 3 *Illustrations*

Front Panel



1. **POWER** key. Press to turn on monitor.
2. Low Battery Indicator. Illuminates (red) if monitor powered from battery. Flashes to warn of low battery voltage condition.
3. AC Power Indicator. Illuminates (green) if monitor is connected to AC (Mains) and the rear panel power switch is set to "|".
4. Two Minute Silence Indicator. Illuminates (yellow) when the **AUDIO** key is pressed. Alarms silenced for two minutes.
5. **AUDIO** key. Press and release to turn on/off the two minute silence function. Press and hold to enable the Audio Off feature (unless disabled via Options Menu). Press and release to disable Audio Off.
6. Audio Off Indicator. Flashes (yellow) as a warning that the audible alarms are disabled.
7. ALERT RESET **ALERT RESET** key. Press to disable active alert indicators. Alerts will reactivate if alert condition still exists.
8. Alert Indicator. Flashes (red) when an alert/alarm occurs. Continues to flash until condition corrected and ALERT RESET **ALERT RESET** is pressed.
9. **SOFTKEYS**. Press software keys 1-5 (left to right) to initiate action listed above each key.
10. Kickstand and bedrail hanger.
11. EVENT **EVENT** key. Press to place an "event marker" into the trend.
12. Red Alert Bar. Flashes (red) when an alert/alarm occurs. Continues to flash until condition corrected and ALERT RESET **ALERT RESET** is pressed.
13. SpO_2 Sensor Input Connector.
14. Contrast key. Press to adjust display for optimum viewing.
15. Waveform or trend data displayed here.
16. Menu Display. Softkey functions and menu messages displayed here.
17. Parameter Numerical Displays. Numerical displays and alert limit settings for measured parameters displayed here. Also display units and special display options noted here.

Rear and Top Panel


NOVA METRIX
MEDICAL SYSTEMS INC.
WALLINGFORD, CONNECTICUT U.S.A.
RS232C/NOVAMETRIX ACCESSORIES
REPLACE FUSE
AS MARKED
0.5A S.B. (2)/100-120V
T250mA (2)/200-240V
CAUTION: FEDERAL (U.S.A.) LAW RESTRICTS THIS DEVICE TO SALE, DISTRIBUTION, OR USE BY OR ON THE ORDER OF A LICENSED MEDICAL PRACTITIONER.
CAUTION: EQUIPMENT MUST BE GROUNDED AT ALL TIMES TO AVOID DANGEROUS ELECTRICAL SHOCK HAZARD.
PATENTS 5,190,038 5,398,680 OTHER FORIEGN AND U.S. PATENTS PENDING
POWER
100-120-200-240 VAC 50-60Hz 40VA
1
2
3
4
5
6
7
8
9
10
11
12
DANGER - EXPLOSION HAZARD. DO NOT USE IN THE PRESENCE OF FLAMMABLE ANESTHETICS.
CAUTION - ELECTRIC SHOCK HAZARD. DO NOT REMOVE COVERS OR PANELS. REFER SERVICING TO QUALIFIED PERSONNEL.
DANGER - RISQUE D'EXPLOSION. NE PAS EMPLOYER EN PRESENCE D'ANESTHESIQUES INFLAMMABLES.
ATTENTION - RISQUE DE DÉCHARGES ÉLECTRIQUES. NE PAS ENLEVER LES COUVERCLES OU LES PANNEAUX. SE RÉFÉRER POUR L'ENTRETIEN À UN PERSONNEL QUALIFIÉ

1. Ground symbol: Equipotentiality. Connection to monitor's chassis.
2. Line Cord Clip: This clip can be set around the line cord strain relief so that the cord cannot be pulled out of the connector.
3. Line Cord Connector: The AC (Mains) line cord attaches to the monitor here.
4. AC Mains Power Switch: With switch in "O" position, AC Mains voltage does not enter monitor. With switch in "I" position, AC Mains voltage allowed into monitor to power unit and/or charge internal battery.
5. Fuse Compartment: The AC (Mains) line fuse(s) are inside this compartment. Pry open with small screwdriver.
6. AC Mains Voltage: The currently selected AC Mains input voltage is identified here.
7. Serial Output Connector: Serial (RS232) data output here for use with RS232 interfaces. A female 25-pin "D" connector serves as the interface connector.
8. Attention: Consult manual for detailed information.
9. Top Cover
10. Carrying Handle: Monitor carrying handle molded into case.
11. Warning Label: Explosion and electrical shock warnings.
12. Patient Isolation Label: The *Model 2001* is Type BF equipment.

Section 4 Monitor Basics

AC Mains (Line Cord) and Battery Power

AC Operation

The *Model 2001* Pulse Oximeter can operate from AC Mains (line cord) power or from its internal battery. The rear panel power input module must be set to the proper voltage setting and the proper fuses must be installed for safe AC Mains (line cord) operation. The module should indicate the proper voltage setting (115 VAC for use in the U.S.A.). Refer to "Mains Voltage Configuration" on page 58 if this setting needs to be changed.

To operate from AC Mains (line cord) power, plug the line cord into the rear panel power input connector and set the rear panel POWER switch to "I". Connect the other end of the line cord to a properly grounded three-wire outlet.

Battery Operation

Model 2001 can operate for up to three hours while powered from its internal battery (excessive alerting reduces battery life). The monitor is powered from its internal battery whenever the line cord is disconnected or the rear panel POWER switch is set to the "O" (off) position.

While on battery power, *Model 2001* displays a battery icon to the left of the Signal Bar. indicates a fully charged battery, a half charge, and indicates less than 30 minutes of battery life remain. Note: The battery icon appears fully charged for the first minute after switching to battery power; after that it will reflect the true battery charge.

When approximately 15 minutes of battery life remain, the front panel LOW BAT indicator illuminates. Reconnect the monitor to the AC Mains to recharge the battery. The monitor can be operated from the AC Mains while the battery is being recharged. The battery will be fully recharged in 12-15 hours.

If the monitor continues operating on battery power while in the low battery state (illuminated), the battery becomes exhausted and the monitor stops operating. The message BATTERY VERY LOW PLUG IN AC POWER is displayed and a continuous audible tone will sound. The audible tone cannot be silenced, the monitor must be connected to AC Mains for continued operation and to recharge the battery.

If the monitor is allowed to continue operation while in the battery exhausted state, the monitor will automatically shut itself off to avoid excessive discharge and damage to the battery.

Power Key

- If the AC ON icon is illuminated, *Model 2001* is connected to AC Mains (line cord) power, the internal battery is being charged, and the monitor uses line power if turned on.

To operate from AC Mains (line cord) power, plug the line cord into the rear panel AC input connector and set the rear panel power switch to "|". Plug the other end of the line cord to a properly grounded three-wire outlet.

- *Model 2001* can operate for up to 3 hours on battery power. LOW BAT illuminates when 15 minutes of battery power remain. If AC ON is not illuminated, the monitor will operate from battery power.

1. To turn the monitor on or off, press **POWER**.

   Ensure the monitor operates as stated below before applying a sensor to the patient.

   - All displays and indicators illuminate briefly[1]
   - A "beep" indicates the audio is functional
   - MONITOR PERFORMING SELF TEST message is replaced by the Main Menu
   - Perform "Sensor Quick Check", refer to "Finger Sensor Quick Check" on page 21, "Y-Sensor Quick Check" on page 27 or "Single Patient Use SpO2 Sensor Quick Check" on page 30 for the appropriate sensor.

2. Press the (contrast) key to adjust the display for optimum viewing.

3. Press **YES** to erase or press **NO** to retain stored trend information.

   "ERASE STORED TRENDS?" is briefly displayed after power on. To keep the trend data from previous monitoring episodes intact, let the menu time out (trend not erased) or press the softkey below the **NO** menu choice. Press **YES** to erase the stored trend data.

Audio Key

Audible alarms can be silenced in two ways: temporarily or permanently.

- Two Minute Alarm Silence: Press the **AUDIO** key. The (two minute silence) indicator to the left of the **AUDIO** illuminates and audible alarms are silenced for two minutes. After two minutes, the indicator turns off and audible alarms are again allowed to sound. To cancel the two minute silence before the two minutes have elapsed, press the **AUDIO** key again and the silence condition will be cancelled.
- Permanent Audio Off: Press and hold the **AUDIO** key until the (audio off) indicator to the right of the **AUDIO** key starts flashing.[2] No audible alarms will be generated. To cancel the audio off condition, press the **AUDIO** key again: it will stop flashing and audible alarms are again allowed to sound.

ALERT RESET Key

An alert occurs if SpO_2 or pulse rate exceeds the displayed alert limits. Alerts are also generated by conditions such as SENSOR OFF PATIENT. When an alert occurs, the (alert) indicator flashes, and violated limit displays, menu center messages and the red alert bar may flash and an alarm may sound. Once the alert condition is fixed, and other flashing displays may continue even though the audible alarms stop.

1 AC ON will not illuminate unless AC line power is connected and the rear panel POWER switch is set to "|".
2 If AUDIO OFF DISABLED appears when the user activates AUDIO OFF, refer to "Audio Mute" on page 16.

Press the ALERT RESET **ALERT RESET** key to stop an alert condition that is not currently active. Any alert messages, flashing indicators or audible alarms will be disabled. Currently active alert/alarm conditions will be reset and again become active once the appropriate time-out period has elapsed.

In certain non-monitoring conditions such as CONNECT SPO2 SENSOR or SENSOR OFF PATIENT, pressing ALERT RESET **ALERT RESET** will reset (silence) the audible alarms until monitoring is resumed and the monitor again receives valid signals from the sensor.

EVENT *EVENT Key*

Press the EVENT **EVENT** key to place an "event" marker into the monitor's trend memory. Pressing the **EVENT** key while in the Main Menu will freeze the waveform for sixty seconds; the message WAVEFORM FROZEN appears on the display. To return to the real time display before the sixty second time out, press the **RUN** softkey. Pressing the EVENT **EVENT** softkey in menus other than the Main Menu will not freeze the waveform, but the event will be recorded in trend memory. Events are stored in trend memory for use in printouts and trend data examination. The message EVENT MARKED is displayed each time an event is marked from the Main Menu.

When the *Model 2001* is configured for operation with a printer and the EVENT **EVENT** key is pressed, the message PRINT WAVEFORM? will be displayed for 60 seconds. Pressing the **PRNT** key during this time will cause a printout of the waveform; this printout will be the 5 seconds proceeding the freezing of the display.

When the *Model 2001* is configured for operation with the NovaCARD memory module and the EVENT **EVENT** key is pressed, the message STORE WAVEFORM? will be displayed for 60 seconds. Pressing **STORE** will store the waveform to the NovaCARD. Pressing **ID** will bring up the patient identification menu. The **ERASE** softkey will erase the card. Pressing **RUN** will return to real time display.

◐ *Contrast Key*

Press the ◐ (contrast) key to adjust the display for optimum viewing.

The Menu SOFTKEYS

The Menu Center display area is located just above the five unmarked software keys or "softkeys". Softkeys perform the action displayed above each key. For example; above the rightmost softkey in the Main (or Base) Menu is a **MENU** key. Press **MENU** and new menu and softkey functions are displayed. Press **RUN** to return to the Main Menu.

NOTE: **RUN** always displays the Main Menu. **NEXT** and **PREV** (previous) move through the menus one level at a time. The Main Menu will reappear if no key is pressed for one minute (except if trends are displayed, when the time-out is extended to five minutes).

The Main Menu

The Main (or Base) Menu is comprised of the following keys:

- **ALRT** - used to set alert limits, either manually or with Auto Alerts.

- **TRND** - brings up the trend page menus and displays.
- **MENU** - brings up the SYSTEM OPTIONS. Audio volumes, display brightness and SpO_2 averaging times can be set here.

The following keys may also appear in the Main Menu:

- **SIZE** - displayed only if WAVEFORM AUTOSIZE set to **OFF**. Refer to "Waveform Autosize" on page 32.
- **PRNT** - displayed only if PRINTER INTERFACE is selected. Refer to "Printer Interface Mode" on page 41.
- **CARD** - displayed only if NOVACARD INTERFACE is selected. Refer to "NovaCARD Interface Mode" on page 45.

Default Menu Selectable Parameters

Model 2001 retains measurement parameters and system setup information in its memory even while it is turned off. When the monitor is turned back on, the retained settings are restored and will be in effect until they are changed by the user. *Model 2001* is shipped from the factory with its operating parameters set to these default values:

- Alerts: Latched
- Alert Bar Latched: No
- Alert Limits: SpO_2 100-85, Pulse 150-40
- Alert Limits: Retained on start-up
- Alert Volume: Maximum (07)
- Allow Audio Off: Yes
- Averaging: SpO_2 - 8 seconds, Pulse Rate - 8 seconds (fixed)
- Display Brightness: High
- Display Contrast: Center of range
- Display Mode: Blue wave on white background; White text on blue background
- Keyclick Volume: Off (00)
- Limit Alert Delay: Yes (10 seconds)
- Menu Lockout: Off
- Pulse Alert Limits: On
- Pulse Volume: Off (00)
- Serial Interface: Full Format Mode
- Waveform Autosize: On

Returning to Factory Default Settings

The user can reset the monitor back to the factory default settings at any time.

To return the monitor to its factory default settings;

1. Turn the monitor on while depressing the ALERT RESET **ALERT RESET** key.
2. The message PARAMETERS RESET TO FACTORY DEFAULT is displayed.

   The monitor enters its normal operational mode using the factory default values.

Section 5 Alerts

Overview

This section explains *Model 2001* alerts and their possible causes.

Model 2001 provides audible and visible limit alerts for oxygen saturation, and pulse rate. SpO_2 and Pulse Rate each have separate alert limits and limit alerts.

Definitions

Limit Alerts are audible and visible signals from the monitor which are generated in response to SpO_2 or Pulse Rate values outside the range of the Alert Limits—the maximum and minimum allowable values for SpO_2 and Pulse Rate. Alert Limits are the smaller numbers displayed to the left of the SpO_2 and Pulse Rate displays.

Model 2001 is very flexible in handling alerts because it provides several alert options.

- Alert limits can be adjusted automatically with the Auto Alerts feature or manually from within the menu system.
- Pulse Rate limits may be turned off.
- Limit alerts require user action to be reset, but they can be set to automatically reset.
- Alert limit settings are retained in memory and restored each time the monitor is turned on; the monitor can be set to power up each time using default settings.
- Audible alerts are delayed 10 seconds from the occurrence of a limit alert; the delay can be eliminated to allow instant activation.
- Audible alert volume can be adjusted.
- Audible alerts can be temporarily silenced for two minutes.
- Audible alerts can be suppressed altogether via the Audio Off feature; furthermore the Audio Off feature can itself be disabled for use in situations where suppressing audible alerts is undesired.
- The Alert Bar stops flashing automatically if the parameter that caused a limit alert returns within its limits; the Alert Bar can instead be set to continue flashing until the user presses ALERT RESET **ALERT RESET**; the Alert Bar can be turned off altogether.

Audible and visible alerts may also be generated for reasons including violated alert limits, improper sensor placement, interference from electrosurgical units or excessive motion, ambient light interference or low signal strength. Broken or damaged sensors, extension cables or monitors can also cause alerts to occur.

Limit Alerts

If SpO_2 or Pulse Rate violates an alert limit setting:

- The violated alert limit display starts to flash.
- The red (bell-shaped) indicator beside the ALERT RESET **ALERT RESET** key starts to flash.
- A message flashes in the Message Center (for example SpO2-LOW)

If the parameter returns within its limits before 10 seconds elapse:

Assuming the 10 SECOND ALERT LIMIT DELAY is ON (the default setting):

- The indicator, the violated limit display and the alert message stop flashing

If the limit alert lasts for more than 10 seconds:

(Or the 10 SECOND ALERT LIMIT DELAY is OFF.)

- An audible alarm will sound
  (Two Minute Silence and Audio Off features silence the audio. Refer to "Audio Key" on page 8.)
- The Alert Bar to the right of the display starts to flash
  (unless Bar option in the Alert Options menu has been changed. Refer to "Alert Bar—Latched/Unlatched/Off" on page 15.)
- The violated limit becomes latched (unless the Latched option in the Alert Options menu has been changed to No. Refer to "Limit Alerts—Latched/Unlatched" on page 13.)

If the parameter returns within limits after 10 seconds of alerting:

- The audible alarm will turn off
- The Alert Bar will stop flashing
  (unless Bar option in the Alert Options menu has been changed. Refer to "Alert Bar—Latched/Unlatched/Off" on page 15.)
- If the limits are latched, the indicator and violated limit display continue to flash until the user presses the ALERT RESET **ALERT RESET** key. (This allows the user to determine which limit was violated.)
- If the limits are unlatched, the indicator and violated limit display stop flashing.

Auto Alert Limits

Auto Alerts allow the user to bracket the alert limits based on recent patient data.

To set Auto Alert Limits:

1. The sensor must be applied and the monitor displaying SpO_2 and Pulse Rate.

   NOT ENOUGH DATA TO SET AUTO LIMITS is displayed if **AUTO** is pressed before sufficient SpO_2 and Pulse Rate data is acquired. The limits in this case are not changed.

2. Press the **ALRT** softkey and SET ALERT LIMITS appears.

3. Press the **AUTO** softkey.

   The monitor sets the new limit values and displays AUTO ALERT LIMITS SET.

4. The Main Menu returns automatically.

SpO_2 Auto Alert Limits

The SpO_2 high auto alert limit is set to 5 more than the SpO_2 value displayed when the **AUTO** was pressed (maximum setting =100). The low auto alert limit is set to 5 less than the SpO_2 value displayed when **AUTO** was pressed. (minimum setting = 50).

For example, if the SpO_2=98% when **AUTO** is pushed, the system will set the upper alert limit to 100 (98+5=103 with max of 100) and the lower alert limit to 93 (98-5=93).

Pulse Rate Auto Alert Limits

The pulse rate high auto alert limit is set at 25% more than, and the low auto alert limit is 25% less than, the pulse rate value that was displayed before **AUTO** was selected (maximum = 249 and minimum = 30).

For example, if the pulse rate=72 when **AUTO** is pushed, the system will set the upper alert limit to 90 (72+25%=72×1.25=90) and the lower alert to 54 (72-25%= 72×0.75=54).

Setting Alert Limits Manually

The user can manually adjust the SpO_2 and Pulse Rate alert limits.

WARNING: Care should be exercised to ensure clinically reasonable alert limit settings are selected. Novametrix does not recommend the setting of limit values to such a wide span as to effectively render the alert limit feature useless. Once the limit values are properly set, the user should periodically confirm patient status by alternate means and not rely solely on alerts generated when a limit is violated.

Alert limit adjustment ranges are:

- SpO_2 - High 100-55, Low 95-50
- Pulse Rate - High 249-35, Low 244-30
- Pulse Rate alerts can be turned off if the High limit is raised above 249 or the Low limit is dropped below 30. If the Pulse Rate limits are off, the limits display OFF and no Pulse Rate limit alerts are generated.

To manually set the alert limits:

1. Press the **ALRT** softkey and SET ALERT LIMITS appears.
2. Press **SEL** (select) to move "◀" to the limit to be changed.
3. Press ↑ or ↓ to increase or decrease the selected limit.

   Press and release the arrow keys to change the limit value one digit at a time.
   Press and hold the arrow keys to make the value change more rapidly.

   WARNING: *Model 2001* will not allow a parameter's high and low alert limits to be set to within 5 digits of each other. For example, using default values, if the upper Pulse Rate limit is lowered to 44, the Pulse Rate low limit will change from 40 to 39 in order to maintain the 5 digit difference between limits.

4. Once all limits are set as desired press **RUN**.

Limit Alerts—Latched/Unlatched

Alerts caused by a parameter violating an alert limit setting are normally "Latched". Once a latched alert is active for 10 seconds, even if the parameter then returns within its limits, the violated alert limit display

and the 🔔 indicator continue to flash until the user presses the ALERT RESET **ALERT RESET** key. This indicates which parameter caused the alert.

Model 2001 also supports "Unlatched" alerts that automatically stop the flashing of the violated alert limit display and the 🔔 indicator as soon as the alerting parameter returns within its limits. The user does not have to press the ALERT RESET **ALERT RESET** when unlatched alerts are in use.

To select Latched or Unlatched alerts:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until ALERT OPTIONS 1 appears.
3. Press **LATCH** and ALERTS LATCHED appears.

   The current setting flashes.
4. Press **YES** or **NO** as desired.

   YES provides latched alerts that require the user to press ALERT RESET **ALERT RESET** to clear them
   NO provides unlatched alerts that reset automatically without user intervention.

   NOTE: Once the choice of Latched or Unlatched alerts is made, that choice will remain in effect, even if the monitor is turned off and on, until changed by the user.
5. ALERT OPTIONS 1 reappears. Press **RUN** to return to the Main Menu.

Alert Limit Settings—Retained/Defaults

When *Model 2001* is powered on, it restores the (Retained) alert limit settings that were in effect when the monitor was last turned off. However, the monitor can be configured to use its (Default) start-up values at each power up instead.

To use Retained or Default alert limit settings at power up:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until ALERT OPTIONS 1 appears.
3. Press **DFLT** (default) and RETAIN ALERT LIMITS appears.

   The current setting flashes.
4. Press **YES** or **NO** as desired.

   YES. The monitor powers up using the alert limit settings from the previous use.
   NO. The monitor powers up using default alert limits: SpO_2 100-85, Pulse Rate 150-40.

   NOTE: Once the choice of Retained or Default alert limit settings is made, that choice will remain in effect, even if the monitor is turned off and on, until changed by the user.
5. ALERT OPTIONS 1 reappears. Press **RUN** to return to the Main Menu.

Alerts—Delayed/Instant

When SpO_2 or Pulse Rate violates an alert limit, the violated limit display and the 🔔 indicator start to flash immediately, but the audible alarm and Alert Bar (if enabled) are delayed 10 seconds. This delay

helps avoid "nuisance" alarms, because the alert will be cancelled if the parameter returns within its limits during that first ten seconds.

The 10 second audible and Alert Bar delay can be eliminated if the user desires, and the monitor will activate audible and Alert Bar alerts as soon as an alert limit is violated. Eliminating the delay also has the effect of latching the alert as soon as it occurs. Refer to "Limit Alerts—Latched/Unlatched" on page 13.

To select or eliminate the 10 second audible and Alert Bar delay for limit alerts:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until ALERT OPTIONS 2 appears.
3. Press **DELAY** and 10s LIMIT ALERT DELAY (violation) appears.

   The current setting flashes.
4. Press **YES** or **NO** as desired.

   YES. Audible and Alert Bar alerts for violated alert limits are delayed 10 seconds.
   NO. Audible and Alert Bar alerts occur as soon as an alert limit is violated.

> **NOTE:** Once the Alert Delay setting is decided, that choice remains in effect, even if the monitor is turned off and on, until changed by the user.

5. ALERT OPTIONS 2 reappears. Press **RUN** to return to the Main Menu.

Alert Bar—Latched/Unlatched/Off

The Alert Bar to the right of the monitor display can be set to operate in three different modes. The Alert Bar can be Latched, Unlatched, or turned off altogether.

A "Latched" Alert Bar starts to flash as soon as a limit alert occurs. If the alerting parameter returns within its limits before 10 seconds elapse, the Alert Bar turns off. If the alert condition lasts for more than 10 seconds, the flashing Alert Bar becomes "latched" and will continue to flash, even if the alerting parameter returns within its limits, until the user presses the ALERT RESET **ALERT RESET** key.*

An "Unlatched" Alert Bar starts flashing 10 seconds after an alert limit violation occurs and turns off as soon as the alerting parameter returns within its limits, regardless of the duration of the alert.

The Alert Bar will not flash under any condition if it has been turned "Off".

> **NOTE:** The red (bell shaped) indicator to the left of the ALERT RESET **ALERT RESET** key will always flash whenever a limit alert occurs. Unlike the Alert Bar, the cannot be turned off.

To turn the Alert Bar on (latched or unlatched) or off:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until ALERT OPTIONS 2 appears.
3. Press **BAR** and ALERT BAR LATCHED appears.

   The current setting flashes.
4. Press **YES** or **NO** or **OFF** as desired.

*However, if Unlatched Alerts are selected (See "Limit Alerts—Latched/Unlatched" on page 13), the Alert Bar will turn off once the alerting parameter returns within its limits.

YES. Alert Bar starts to flash as soon as a limit alert occurs.
NO. Alert Bar starts flashing 10 seconds after an alert limit violation occurs.
OFF. Alert Bar will not flash under any condition.

NOTE: Once the Alert Bar setting is decided, that choice remains in effect, even if the monitor is turned off and on, until changed by the user.

5. ALERT OPTIONS 2 reappears. Press **RUN** to return to the Main Menu.

Alert Volume

The volume of the monitor's audible alert is user adjustable. The alert volume feature cannot be used to eliminate audible alerts because the alert is still audible at its lowest setting. Use the **AUDIO** key to temporarily or permanently silence alerts. Refer to "Audio Key" on page 8.

To vary the audible alert volume;

1. Press the **MENU** softkey and the SYSTEM OPTIONS appears.
2. Press the **AUDIO** softkey and SET AUDIO FEATURES appears.
3. Press the **ALERT** softkey and SET ALERT VOLUME appears.

   An audible tone sounds and the current alert volume setting (01-07) is displayed between the up and down arrows.
4. Press ↑ or ↓ to increase or decrease the alert volume setting.
5. Press **RUN** to return to the Main Menu.

Audio Mute

In situations where preventing the occurrence of audible alarms by use of the Audio Off feature is not desired, the monitor can be set to disallow use of Audio Off.

Once the monitor is set to disallow use of Audio Off, AUDIO OFF DISABLED is briefly displayed in the Message Center each time the user tries to enable Audio Off.

NOTE: Unlike Audio Off, the Two Minute Silence feature, which temporarily silences the audible alarms for two minutes and then reactivates them, is a separate feature and is not affected by the status of Audio Mute feature.

To enable or disable the monitor's ability to permanently silence the audible alarms:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until ALERT OPTIONS 1 appears.
3. Press **MUTE** and ALLOW AUDIO OFF appears.

   The current setting flashes.
4. Press **YES** or **NO** as desired.

YES. The user can use Audio Off to permanently silence audible alerts.
NO. The user cannot use Audio Off. AUDIO OFF DISABLED is displayed instead.

NOTE: Once the decision to allow or disallow the user to use Audio Off is made, that choice remains in effect, even if the monitor is turned off and on, until changed by the user.

5. ALERT OPTIONS 1 reappears. Press **RUN** to return to the Main Menu.

Faults, Alerts and Errors

Listed below are the fault, alert and error conditions displayed by *Model 2001*.

Alert Limit Messages

PULSE-HIGH	Selected pulse rate high alert limit has been violated.
PULSE-LOW	Selected pulse rate low alert limit has been violated.
PULSE OUT OF RANGE	Pulse rate is less than 30 bpm or is greater than 250 bpm.
SpO2-HIGH	Selected saturation high alert limit has been violated.
SpO2-LOW	Selected saturation low alert limit has been violated.

Fault and Error Condition Messages

SENSOR OFF PATIENT	Sensor disconnected from patient, improperly applied, or placed on an area too translucent for proper sensor operation. Reposition sensor.
BAD SIGNAL TIMEOUT	Monitor not receiving valid signals from sensor. May be caused by excessive motion, cardiac arrhythmia or other situations leading to poor signal. Check patient status, reposition sensor. Changes to PULSE SEARCH after 30 seconds.
CONNECT SpO2 SENSOR	1. Sensor is disconnected from the monitor. 2. Sensor is faulty. Remove sensor from use and contact qualified service personnel. 3. Sensor is placed on a site too thick. Reposition the sensor on a thinner (less opaque) section of tissue.
ERROR - FAULTY SENSOR	Sensor faulty. Remove sensor from use and contact qualified service personnel.
INSUFFICIENT LIGHT	Sensor placed on a site too thick (or opaque) for adequate light transmission. Changes to REPOSITION SENSOR after 30 seconds. 1. A non-SuperBright™ sensor is connected, use only 87xx series sensors. 2. Sensor is faulty. Remove sensor from use and contact qualified service personnel.
LIGHT INTERFERENCE	Ambient light sources (sunlight, warming lights, etc.) are interfering with sensor light sources. Shield the sensor from ambient light sources. Changes to REPOSITION SENSOR after 30 seconds.

LOW SIGNAL STRENGTH	Pulse strength as detected by sensor is too weak for proper monitor operation. Reposition sensor. Changes to REPOSITION SENSOR after 30 seconds.
MONITOR ERROR *	Monitor faulty, where * is a message or error code. Record error message (appearing on bottom line of display) and contact qualified service personnel.

Miscellaneous Messages

AUDIO OFF DISABLED	Displayed if user tries to enable Audio Off mode (by pressing and holding the AUDIO key) while the "Allow Audio Off" portion of the Options Menu is set to "No".
BATTERY VERY LOW PLUG IN AC POWER	1. Monitor is running on battery power and the battery power has been depleted. Connect line cord to AC Mains power source and set the rear panel switch to "I" 2. Monitor's rear panel fuse has blown, monitor switched over to battery power and has depleted battery life. Contact qualified service personnel.
EVENT MARKED	An event was successfully entered into trend memory.
MONITOR PERFORMING SELF TEST.	Monitor is performing its power up system diagnostic tests.
Parameters Reset To Factory Default	Displayed when monitor is turned on while pressing the ALERT RESET **ALERT RESET** key, or if an error found in battery-backed RAM during power on. Monitor now using factory default settings.
DSP SERIAL TIMEOUT or DSP NOT RESPONDING	The main microprocessor has lost communication with the Digital Signal Processor. This message will be displayed for 10 seconds then the monitor will reset. The error should be recorded and reported to service if the message is persistant.
DSP ERROR	System error has been detected on the Main Board. This message will be displayed for 10 seconds then the monitor will reset. The error should be recorded and reported to service if the message is persistant.

Section 6 — *SpO_2 Sensors*

The *Model 2001* Pulse Oximeter supports SuperBright SpO_2 Finger and Y-Sensors.

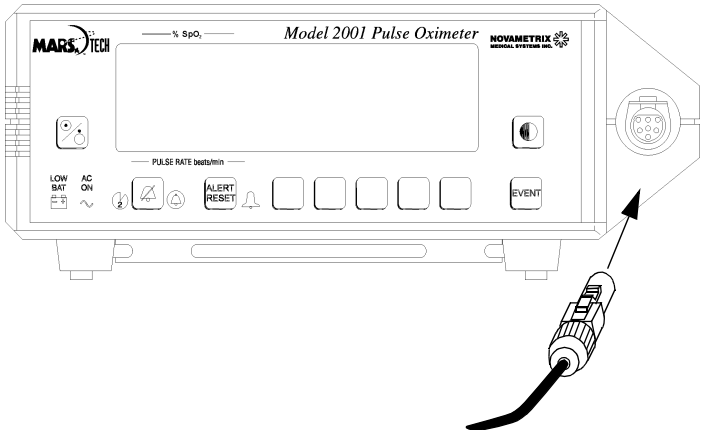
WARNING: Connect only Novametrix saturation sensor extension cables and/or SuperBright SpO_2 sensors to the *Model 2001*. DO NOT use other sensors or accessories with *Model 2001*.

Before connecting to the patient or to *Model 2001*, ensure sensor extension cables and/or sensors are physically intact, with no broken, frayed or damaged components.

Verify the sensor's integrity by performing the Quick Check associated with the proper sensor. See "Finger Sensor Quick Check" on page 21, and "Y-Sensor Quick Check" on page 27

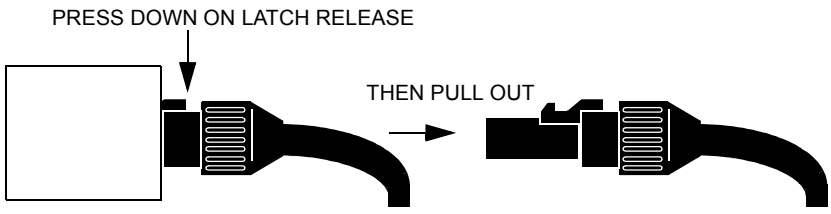
To attach a SuperBright sensor or sensor extension cable to *Model 2001*:

1. Plug the connector into the front panel SpO_2 input.



The connector clicks into place when properly seated. Do not twist the connector. Sensors may be connected to or removed from the monitor whether or not the monitor is turned on.

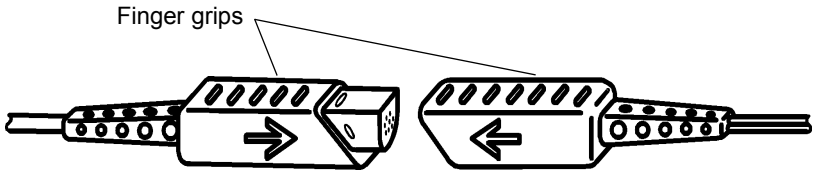
2. To disconnect, press the latch release lever and pull the connector from the monitor. Do not twist the connector.



OxySnap™ Connectors

To connect an Oxy*Snap* extension cable to an Oxy*Snap* SuperBright sensor:

1. Align the arrows on the Oxy*Snap* connectors and press the connectors together.

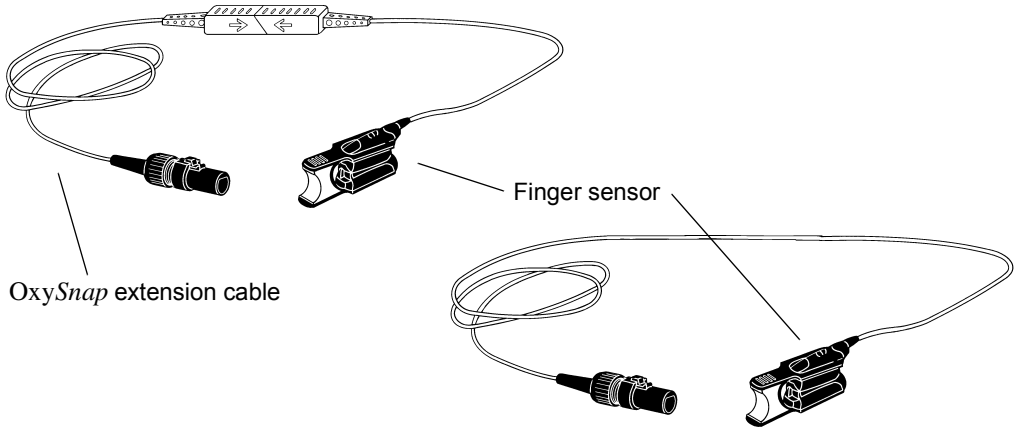


Oxy*Snap* connector

2. To disconnect, grasp the connectors at the finger grips and pull them apart.

Finger Sensor

The Finger Sensor is intended for adult or appropriate sized pediatric fingers, and is not designed for neonatal applications.



1. Gently squeeze the grips at the rear of the sensor (indicated by arrows below).

2. Position fingertip against placement guide with fingernail towards the red light.

   Do not position the finger so as to protrude past the placement guide.

3. Release the finger grips.

WARNING: Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

4. To remove sensor, gently squeeze grips and slide the sensor from the finger.

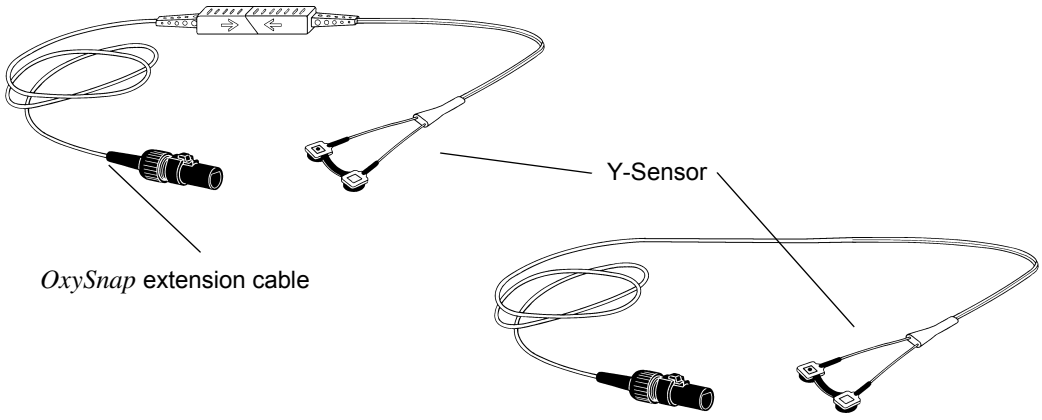
CAUTION: Overstretching the pulse oximeter finger sensor can damage the sensor and potentially affect pulse oximeter readings. Do not stretch the finger sensor open beyond the limit for which it was designed. Overstretching can be prevented: avoid opening the sensor by any means other than squeezing the grips; *DO NOT* force the sensor onto large objects such as a bedrail.

Finger Sensor Quick Check

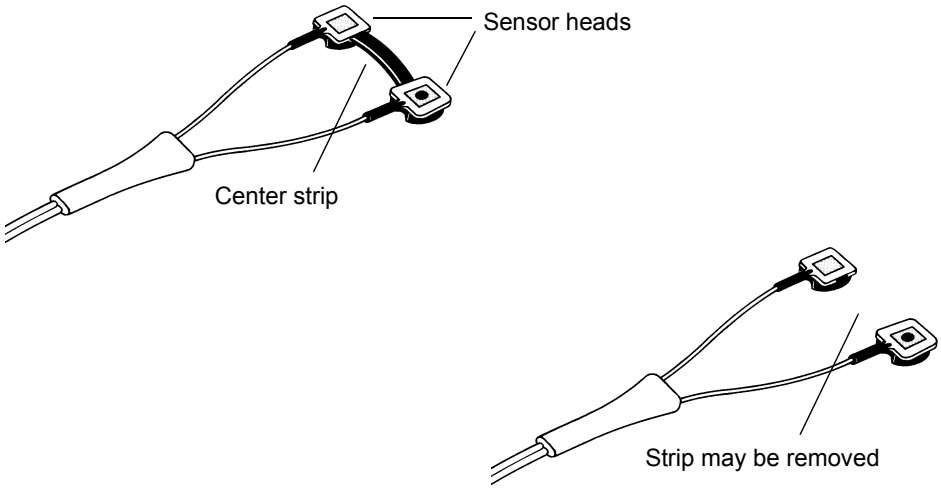
1. Is SENSOR OFF PATIENT displayed when the sensor is connected to the monitor but not applied to the patient?
2. Apply the sensor to your index finger. Are reasonable SpO_2 and pulse rate values displayed?
3. A YES to BOTH #1 and #2 indicates the sensor is OK. Apply the sensor to the patient as instructed above.

Y-Sensor

The reusable Y-Sensor is a flexible sensor designed for use on any patient.It is secured to the patient using a Y-Strip tape, foam wrap, or ear clip (see below).

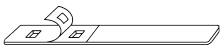
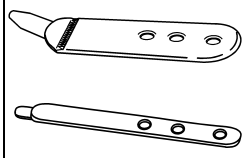
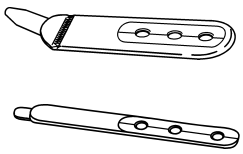


The Y-Sensor's center strip is not a functional part of the sensor. Its purpose is to aid in the placement of the sensor into the tape or other securing system. The center strip may be removed (carefully cut away) if the distance between the sensor heads needs to be other than 25 mm.



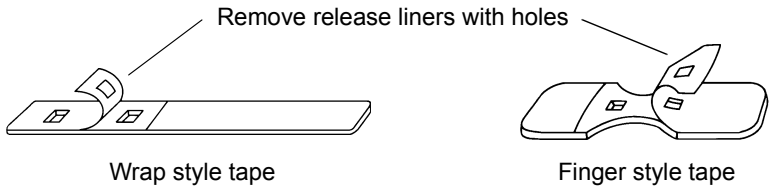
Y-Sensor Application using Y-Sensor Tapes or Foam Wrap

Select a Y-Strip based on the patient type and intended sensor location.

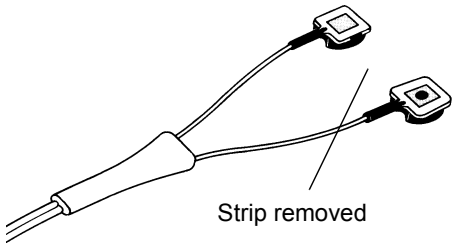
	**Wrap Style Tapes:** Y-Strip tapes are available in two color coded sizes: 25 mm tapes have green liners, and 20 mm tapes have blue liners. The size refers to the distance between the holes in the tape. • Catalog No. 8828: 20mm (blue) neonatal foot, hand, pediatric toe, finger • Catalog No. 8829: 25mm (green) neonatal foot, hand
	Finger Style Tapes: • Catalog No. 8831: 20mm (blue) pediatric finger, adult finger • Catalog No. 8832: 25mm (green) adult finger
	**Non-Adhesive Foam Wraps:** • Catalog No. 8836, Large: adult/pediatric finger, neonatal/pediatric foot or hand • Catalog No. 8943, Small: neonatal foot or hand, pediatric toe or finger
	**Adhesive Foam Wraps:** • Catalog No. 6929, Large: adult/pediatric finger, neonatal/pediatric foot or hand • Catalog No. 6968, Small: neonatal foot or hand, pediatric toe or finger

To use the Y-Strip tapes:

1. Remove the portion of the release liner containing the holes.

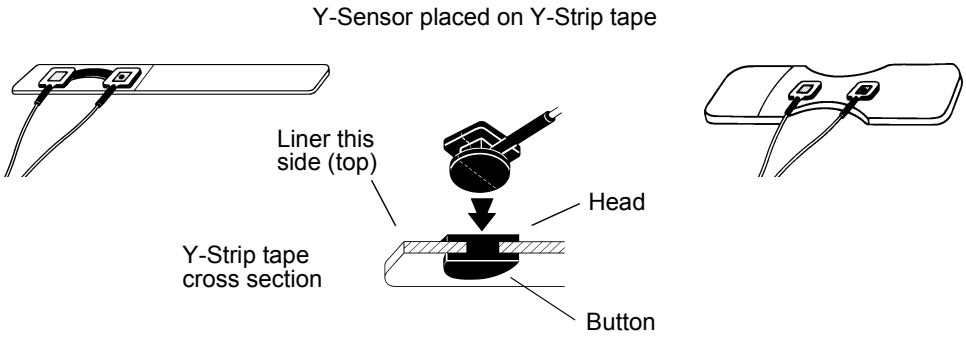


2. *Skip this step if using the 25 mm Y-Strip tape.*
   If using the 20 mm Y-Strip tape, carefully remove the sensor's center strip using a pair of scissors or a sharp blade.



3. Press the "button", on the back of each sensor head, through a hole in the tape.

   Press in from the sticky side of the tape. The tape will stretch to fit the sensor button.

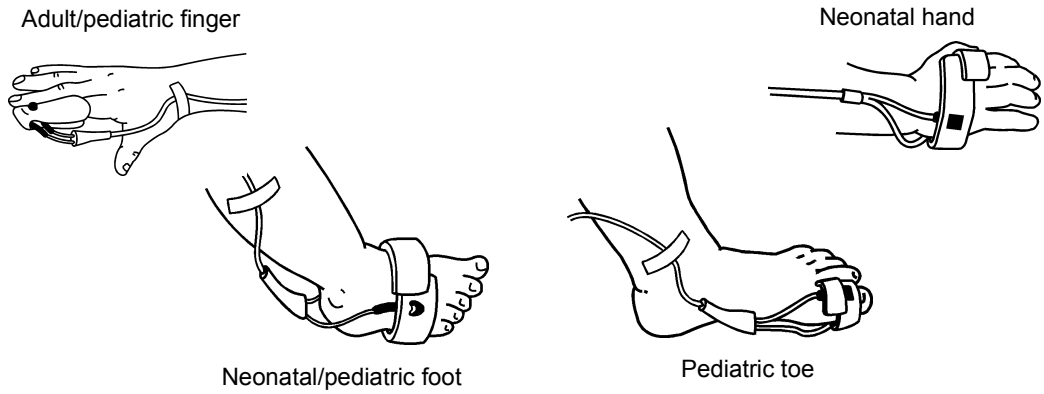


4. Remove the remaining release liner and apply the sensor/tape to the patient.

   Ensure that the sensor heads are directly opposite each other through the tissue. This prevents the sensor from being placed on a site too thick (high arch) for proper operation.

5. To maximize sensor life, secure the sensor cable to the patient with surgical tape.

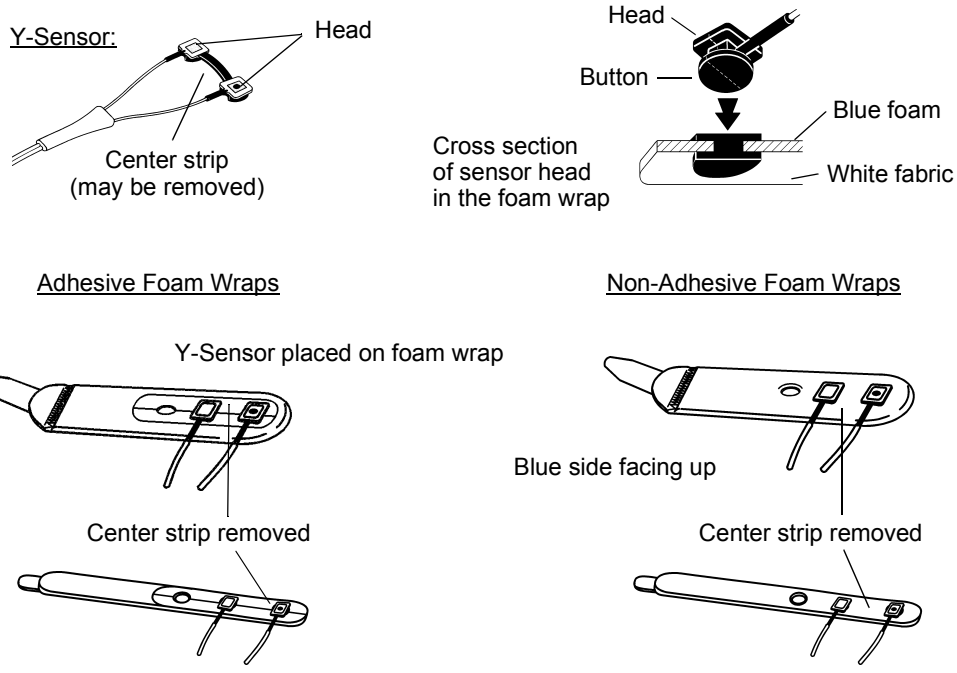
Leave slack in the wires between the tape and the sensor.



WARNING: Do not wrap the tape around the limb so tightly that circulation is restricted. Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

To use the adhesive or non-adhesive foam wrap:

1. With the blue side of the foam wrap facing up, press the buttons on the back of each Y-sensor head through the holes in the foam wrap. The wrap will stretch to fit the buttons. The white side of the foam should show two blue circles where the buttons were pushed through.

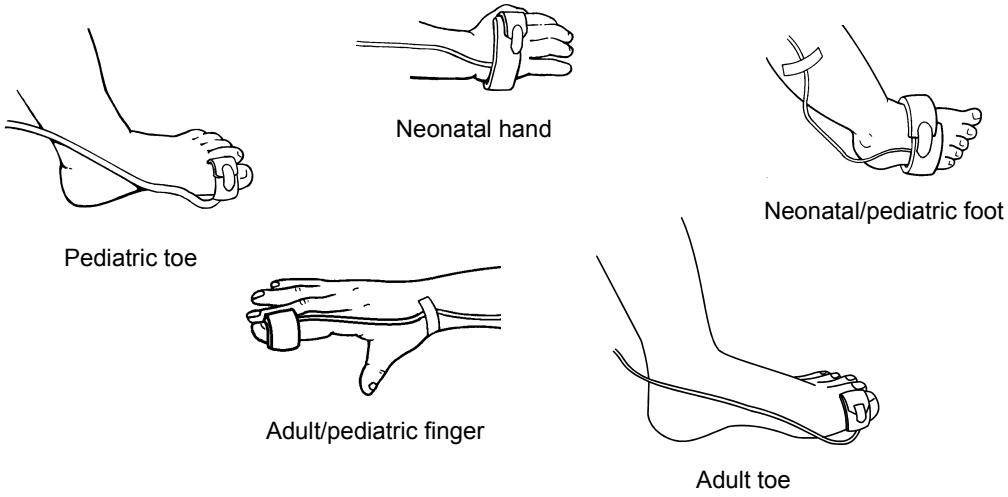


NOTE: If using the first and third holes on the foam wrap it may be necessary to cut the middle strip off the Y-sensor.

2. If you are using an adhesive wrap, remove both sides of the release liner. Face the blue side of the wrap toward the skin and wrap around the site (Velcro tab may be removed and replaced to allow excess foam to be cut as necessary). Secure with the Velcro® tab.

WARNING: Do not wrap the tape around the limb so tightly that circulation is restricted. Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

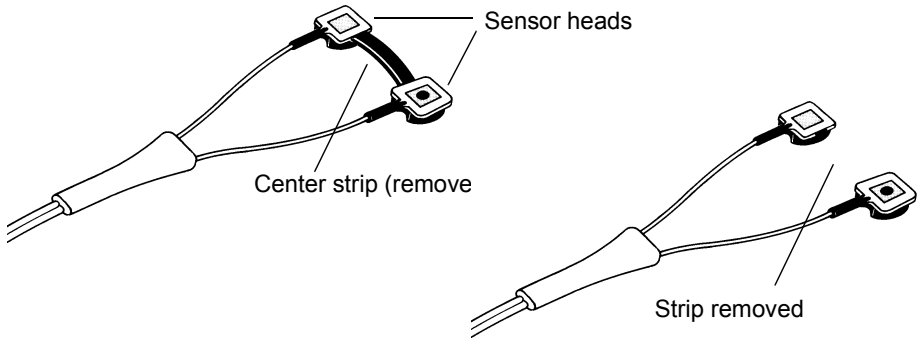
3. *Ensure the sensor heads are directly opposite each other through the tissue.* This prevents the sensor from being placed on a site too thick for proper operation.



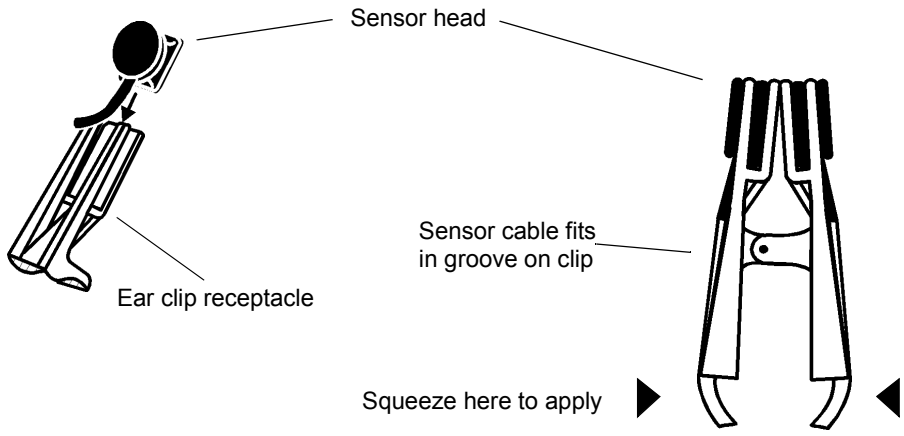
WARNING: Treat foam wrap in accordance with hospital protocol for single-patient use. Check site regularly to ensure adequate circulation and proper sensor positioning.

Y-Sensor Application using the Ear Clip

1. Remove center strip from the Y-Sensor.

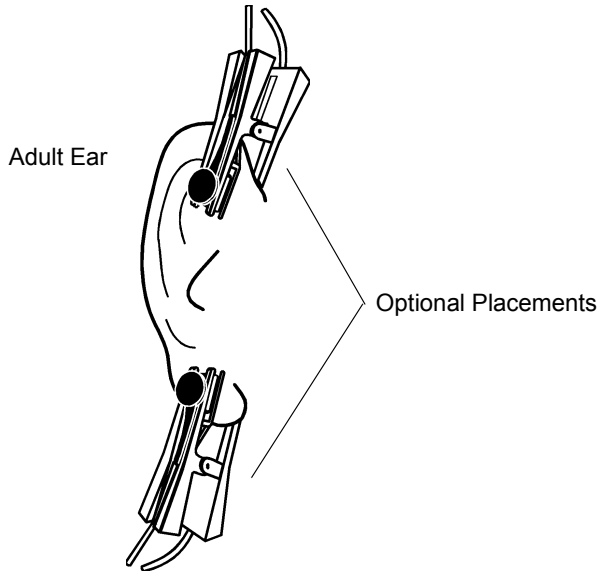


2. Slide each Y-Sensor head into the ear clip receptacles, the heads should face each other.



3. Gently squeeze the end of the ear clip (shown in diagram), and apply the sensor to the patient.

   If a satisfactory reading cannot be obtained, rub the site and/or use adhesive dots for better response. The adhesive dots (PN: 8700-00) included with the ear clips will also help in preventing the ear clip from falling off (e.g. during exercising).



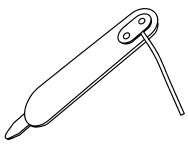
WARNING: Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

Y-Sensor Quick Check

1. With the Y-Sensor connected to the monitor but not applied to patient, position the sensor heads so that they face each other (the red light shines at the detector). Is "SENSOR OFF PATIENT" displayed?
2. Tape the Y-Sensor to your index finger. Does the monitor show reasonable SpO_2 and pulse rate values?
3. A YES to BOTH #1 and #2 indicates that the sensor is working properly. Apply the sensor to the patient as instructed above. The quick check is also a functional test of the extension cable.

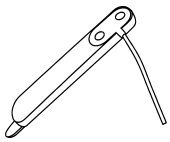
Single Patient Use SpO_2 Sensors

Select an SpO_2 sensor based on the patient type.



Single Patient Use Pediatric/Adult Sensor (Catalog No. 6455):

- The single patient use SpO_2 sensor can be used when monitoring adult or pediatric patients with Novametrix Pulse Oximeters (SuperBright series).



Single Patient Use Neonatal/Pediatric Sensor (Catalog No. 6480):

- The single patient use SpO_2 sensor can be used when monitoring neonatal or pediatric patients with Novametrix Pulse Oximeters (SuperBright series).

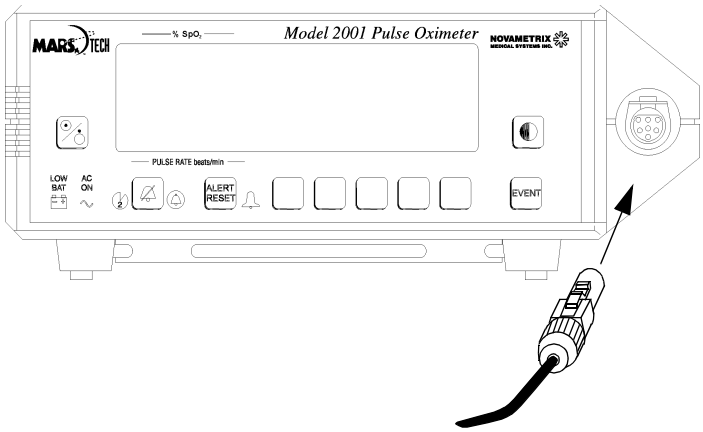
WARNING: Use the Single Patient Use sensor and DB-9 extension cable only with Novametrix SuperBright compatible pulse oximeters. Use with any other device may result in equipment damage or patient injury.

CAUTION: These SpO_2 sensors are intended for single patient use. The sensors can be reapplied to various sites on the same patient but should not be used on multiple patients. Do not attempt to clean or disinfect the sensor, as system performance will be compromised.

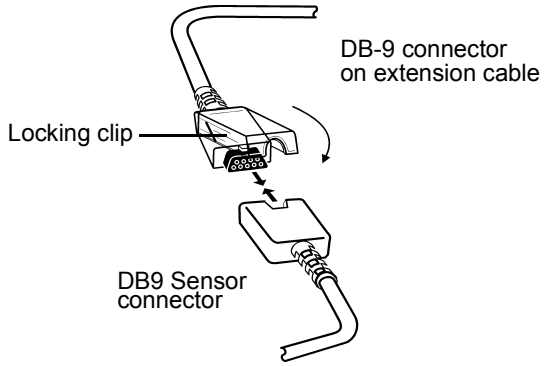
NOTE: The Single Patient Use sensor should be discarded if sensor integrity becomes questionable.

Single Patient Use SpO_2 Sensor Application

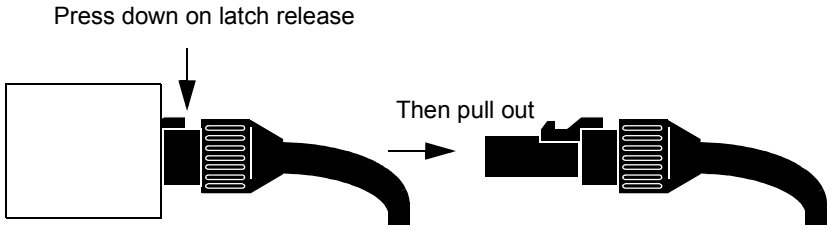
1. Connect the DB-9 extension cable to the *Model 2001* front panel connector.



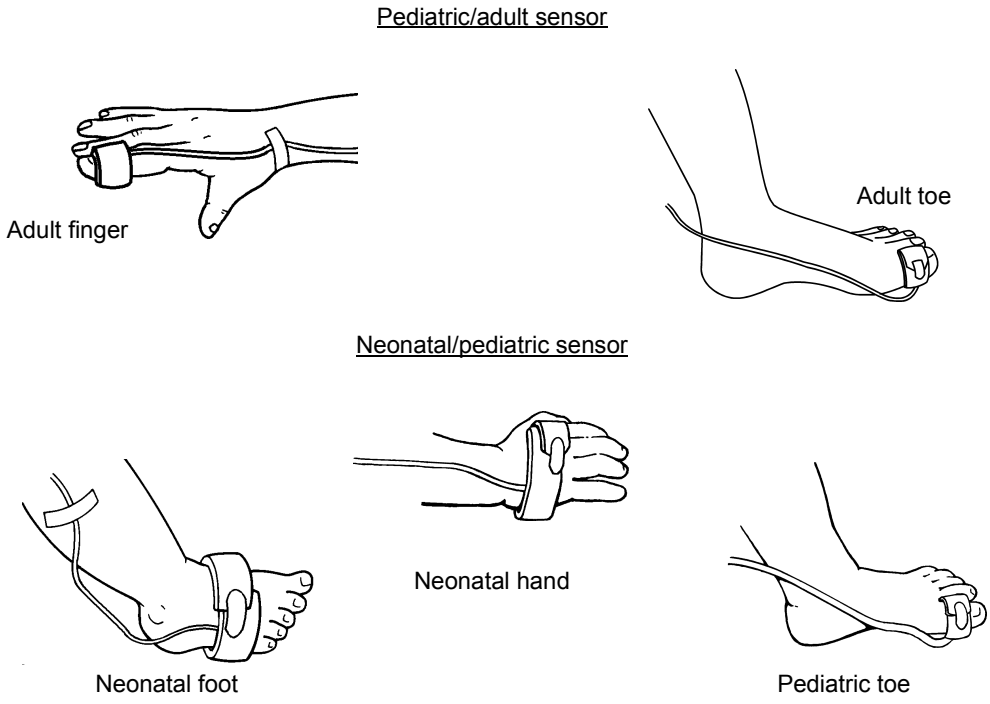
2. Press the DB9 connector on the end of the extension cable into the connector on the end of the Single Patient Use sensor. Close the locking clip until it snaps around the sensor cable.



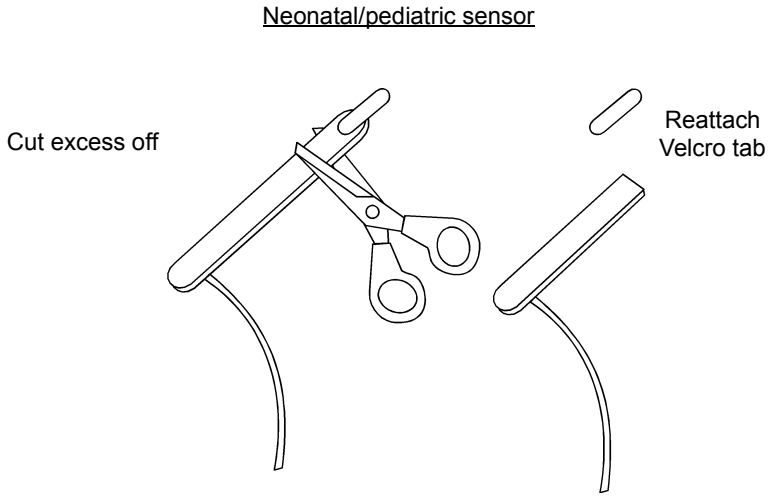
3. To disconnect the DB-9 extension cable from the sensor, open the locking clip, grasp the connectors and pull them apart.
   To disconnect the extension cable from the *Model 2001*, press the latch release lever on the extension cable connector and pull the connector straight back away from the monitor. DO NOT twist the connector.



4. Select the appropriate size sensor based on the patient type.



5. To apply the sensor, place the blue side of the sensor wrap against the skin, wrap it around the site and secure with Velcro® tab. The Velcro tab on the neonatal/pediatric version is removable to allow the foam wrap to be cut before applying to the patient.



Ensure that the sensor heads are positioned directly opposite each other through the tissue. The adhesive dots (Catalog No. 8700) which are included with each sensor can be applied to the sensor before patient application for additional adhesion to the site.

6. For additional support, secure the cable along the limb with tape.

WARNING: Do not wrap the sensor around the limb so tightly that circulation is restricted. Inspect the site often, at least every four hours, for adequate circulation. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

Single Patient Use SpO_2 Sensor Quick Check

1. With the sensor connected to monitor but not applied to the patient, position the sensor heads so that they face each other (the red light shines at the detector). Is "SENSOR OFF PATIENT" displayed?
2. Attach the Single Patient Use sensor to your index finger. Does the monitor show reasonable SpO_2 and pulse rate values?
3. A YES to BOTH #1 and #2 indicates that the sensor is working properly. Apply the sensor to the patient as instructed above. This quick check is also a function test of the extension cable.

Section 7 SpO_2 and Pulse Rate

Once an SpO_2 sensor is connected to the monitor and properly applied to the patient, numerical SpO_2 and Pulse Rate values appear in the "% SpO_2" and "PULSE RATE beats/min" portion of the display, respectively.

A plethysmographic waveform is displayed and the Signal Bar display gives a qualitative indication of the strength of the pulsatile signal the monitor is receiving.

SpO_2 Display Averaging

The Oxygen Saturation (SpO_2) is determined by a fixed eight second averaging period.

Pulse Rate Display Averaging

Pulse Rate is determined by a fixed eight second averaging period.

Pulse "Beep" Volume

Model 2001 is equipped with an audible pulse beep feature that allows the user to "hear" changes in the patient's SpO_2 and pulse rate. An audible "beep" occurs with each detected pulse beat. The time between beeps indicates the pulse rate.

The pitch of the beep varies with the SpO_2 value. While SpO_2 is greater than or equal to three digits below the SpO_2 high alert limit setting, the highest pitched tone sounds. The beep's pitch decreases with each one digit drop in SpO_2 below that level. There are thirty-two different tones. If the SpO_2 value drops more than 35 percent below the SpO_2 high alert limit setting, the beep remains at the lowest pitched level.

To vary the pulse beep volume:

1. Press the **MENU** softkey and the SYSTEM OPTIONS appears.
2. Press the **AUDIO** softkey and SET AUDIO FEATURES appears.
3. Press the **PULSE** softkey and SET PULSE VOLUME appears.

   The current pulse volume setting (00-07) is displayed between the up and down arrows. A setting of 00 turns off the pulse beep feature.
4. Press ↑ or ↓ to increase or decrease the pulse volume setting.
5. Press **RUN** to return to the Main Menu.

Signal Bar

The Signal Bar reflects pulsatile signal strength as detected by the SpO_2 sensor. Strong signals produce a tall bar; weak signals produce a short bar. Typical signals are 25-75% of the Signal Bar height.

Plethysmogram Display

Model 2001 displays a plethysmogram; a representation of the pulsatile waveform as detected by the SpO_2 sensor. The display is continually updated from left to right. The monitor automatically adjusts the vertical size of the plethysmogram to best fit the display area—maximizing viewability of the waveform. However, this means the waveform gives no indication of pulsitile signal magnitude (refer to the Signal Bar).

Waveform Autosize

The Waveform Autosize feature can be turned off if the user wants the plethysmogram magnitude to reflect detected signal strength.

NOTE: If Waveform Autosize is set to **OFF**, a **SIZE** softkey is displayed in the Main Menu.

To turn the Waveform Autosize feature on or off:

1. Press and hold the **MENU** softkey for 3-seconds. SPO2 SETUP OPTIONS is displayed.
2. Press the **SIZE** softkey and WAVEFORM AUTOSIZE appears.

   The current setting flashes.
3. Press **ON** or **OFF** as desired. SPO2 SETUP OPTIONS reappears.

   ON allows continual automatic adjustment of the magnitude of the plethysmogram. **OFF** allows the user to lock plethysmogram's vertical scaling—making the waveform magnitude reflect relative signal strength.
4. Press **RUN** to return to the Main Menu.

Using the SIZE softkey

With Waveform Autosize turned off, a **SIZE** softkey appears in the Main Menu and during the first thirty seconds after the SpO_2 sensor is applied to the patient, the monitor adjusts the vertical size of the plethysmogram to best fit the display area.

The monitor then "locks" the vertical scaling of the plethysmogram so that subsequent changes in the magnitude of the pulsatile signal cause the plethysmogram to grow smaller or larger—and provide an indication of changes in pulsatile signal strength relative to the "lock" point.

The "lock" point is indicated on the Signal Bar by dots on either side of the bar. Once locked, stronger or weaker signals will still cause the Signal Bar to grow or shrink, but the dots marking the lock point remain in place. These lock points remain fixed until the user presses **SIZE** and a new lock point is determined.

If the magnitude of the patient's pulsatile signal strength changes to the point where the plethysmogram is too small or too large to be of practical value, press the **SIZE** softkey. The monitor will "unlock" the vertical scaling and Signal Bar lock point, display RESIZING PLETH and allow five seconds for the display to reach an optimal display size, then "re-lock" the Signal Bar and plethysmogram display's vertical scale.

Operating Mode Selection

A feature to allow selection of particular modes of operation has been included. There are four choices available: NICU (Neonatal Intensive Care Unit), ICU (Intensive Care Unit), ANST (Anesthesia), and SLEEP (sleep studies). The parameter settings are listed below.

Parameters	NICU	ICU	ANST	SLEEP
Menu	Enabled	Enabled	Enabled	Selectable
Trend Erase on power up?	Enabled	Enabled	Enabled	Disabled
Default SpO_2 limits	upper 94 lower 89	upper 100 lower 85	upper 100 lower 85	upper 100 lower 60
Default pulse limits	upper 180 lower 60	upper 150 lower 40	upper 150 lower 40	upper Off lower Off
Default limits on power up	Yes	No	Yes	No
Backlight	High	High	High	Low
Alert volume	7	3	5	1
Pulse volume	4	0	3	0
Permanent mute status	Disabled	Enabled	Enabled	Enabled
Waveform autoscale	Off	On	On	On
Alert bar latched	Yes	Yes	No	Off
Alerts latched	Yes	Yes	No	No
Allow audio off	No	Yes	Yes	Yes
10 second alert delay	On	On	Off	On
Serial interface	NovaCARD	NovaCARD	NovaCOM1	NovaCOM1
Keyclick volume	1	Off	Off	Off

To select a particular mode of operation:

1. Press and hold the **MENU** softkey for 3-seconds. SPO2 SETUP OPTIONS is displayed.
2. Press the **MODE** softkey and SELECT OPERATING MODE appears.
3. Press **NICU**, **ICU**, **ANST**, or **SLEEP** to select an operating mode. Press **PREV** to return to SPO2 SETUP OPTIONS without making a selection.

   When the desired mode has been selected, the settings for that particular mode will be set and the monitor will return to the Main Menu.

SpO_2 Timer

Model 2001 ensures only valid pulsatile signals are processed. Bad or invalid data causes alerts to occur. These alerts are accomplished with the use of an SpO_2 timer called the Special Alert Delay.

Special Alert Delay

Special alerts include Low Signal Strength, Light Interference and Insufficient Light. These conditions are usually transitory in nature and allowing a delay before alarm activation helps to avoid "nuisance" alarms while still alerting the user to a persistent condition.

An alert message is displayed as soon as a special alert occurs. If the duration of the special alert exceeds the Special Alert Delay (set at 45 seconds), the SpO_2 and Pulse Rate displays will blank out and display "- - -"; the 🔔 indicator starts to flash and the audible alarm will sound (unless disabled by the user).

The Special Alert Delay also controls the blanking of the SpO_2 and Pulse Rate displays.

Section 8 *Trend Memory*

Model 2001 maintains trend information for SpO_2 and Pulse Rate. The 24 hour battery-backed trend memory is continually and automatically updated. Trend memory features include:

- Graphical trend memory displays are user selectable to show any 12 hour, 8 hour, 2 hour, or 30 minute portion of that data.
- Histogram trend memory displays are user selectable to show any 12 hour, 8 hour, 2 hour, or 30 minute portion of that data.
- Graphical trend memory displays are user selectable to show SpO_2 only or SpO_2 and Pulse Rate on the same display.
- User selected "Events" are stored with the trend data.
- Trend memory data in graphical and histogram formats can be output to a printer.
- The user can choose to erase stored trend memory at monitor power up or at any time via the trend menus.

To display trend memory:

1. Press the **TRND** softkey.

   The message DRAWING TREND PLEASE WAIT is momentarily displayed. The message is then replaced with a graphical trend display.

   NOTE: *Model 2001* continues uninterrupted patient monitoring while trends are displayed. Any latched alert that occurs while viewing trend data causes the Main Menu to reappear. If no keys are pressed for 5 minutes, the Main Menu replaces the trend display.

   New trend data is continually collected and enters the graph from the right—pushing older already displayed data towards the left (if less than 12 hours of data have been collected, the graph will be shortened accordingly). Points in the trend where the monitor was turned off are indicated by dotted vertical lines.

2. Move the cursor by pressing the **<-** or **->** (arrow keys) to the desired time.

   Information displayed above the graph is specific to the data at the cursor—the dashed vertical line flashing in the display.

   Press the **<-** (arrow left) key to move the cursor towards older data.
   Press the **->** (arrow right) key to move the cursor towards more recent data.

3. Press the **EXPAND** softkey.

   Successive presses of the **EXPAND** softkey cause the 8 hour, 2 hour and 30 minute trends to be displayed. Press **EXPAND** again to return to the 12 hour trend display.

4. Use the arrow keys to fine tune the cursor to the desired location in the trend.

   The information above the graph includes; the date in the form MMMDD (JAN01), the time in 24 hour format in the form HH:MM:SS (13:30:00 = 1:30 p.m.), SpO_2 (S 97 = 97%), Pulse Rate (P 59 = 59 beats/min). If a trend "Event" was marked, an "E" appears.

5. Press the **RUN** softkey to return to the Main Menu.

Trend Data Compression

SpO_2 and Pulse Rate data is stored in trend memory every eight seconds.

Model 2001 can display any 12 hour, 8 hour, 2 hour, or 30 minute portion of its 24 hour trend memory. Since the size of the trend display is a fixed width, the monitor must compress the trend data to fit onto the display—the more data present, the more it must be compressed to fit onto the display. The *Model 2001* trend display is approximately 200 pixels (picture-element) wide. Each horizontal pixel (data point) is equivalent to the following times:

1 data point per 8 seconds in a 30 minute trend
1 data point per 32 seconds in a 2 hour trend
1 data point per 128 seconds (approx. 2 minutes) in an 8 hour trend
1 data point per 192 seconds (approx. 3 minutes) in an 12 hour trend

The monitor determines the trend duration and compresses that amount of data to fit the screen—older data to the left, the most recent to the right.

Because of the data compression, data at any horizontal pixel may look like a vertical bar. The upper extent of the bar represents the maximum value and the bottom of the bar the minimum value stored during that particular compression period. The SpO_2 and Pulse Rate values displayed above the graph represent the minimum values stored over the compression period.

SpO_2 and Dual Trend Displays

When the **TRND** softkey is pushed, the graphical trend is displayed. The monitor can be set to display SpO_2 only, or both SpO_2 and Pulse rate simultaneously.

SpO_2 only trends display 60-100 % with resolution of approximately one SpO_2 percent per vertical pixel (picture element or "dot"). Dual trends displays SpO_2 60-100 % for full scale and 80-100% for half scale, Pulse Rate of 50-250 beats/min for full scale and 50-150 beats/min for half scale, with approximate resolutions of two SpO_2 percent per vertical pixel and ten Pulse Rate beats/min per vertical pixel.

Selecting SpO_2 only, or Dual display

To select Dual (SpO_2 and Pulse Rate) or SpO_2 only trend displays:

1. Press the **TRND** softkey to select trend display.
2. Press the **NEXT** softkey and TREND OPTIONS are displayed.
3. Press **VIEW** and TREND VIEW is displayed.
4. Press **DUAL** to display both SpO_2 and Pulse Rate trends
   or press **SpO2** to display only SpO_2 trend data.

   The monitor will retain the display option selected even when the monitor is turned off.

Changing Scale in Dual Trend display

To select Full or Half scale display for SpO_2 or Pulse in dual display:

1. Select dual trend display as described above.
2. Press **NEXT** softkey and TREND OPTIONS are displayed.
3. Press **VIEW** and TREND VIEW appears.
4. Press **SCALE** and TREND SCALE is displayed.
5. Press **SPO2** or **PULSE** as desired, FULL or HALF will appear.

   The current selection will flash.
   The vertical scale for SpO_2 at Half will be 80-100%, at Full 60-100%.
   The vertical scale for Pulse at Half will be 50-150 beats/min, at Full 50-250 beats/min.

Histogram Trend Display

Histogram display provides a neatly tabulated and easily interpreted summary of SpO_2 and Pulse Rate trend memory.

The histogram display reflects the currently selected graphical trend expansion setting. For example, if the graphic display is set to 12 hours, the resulting histogram will also reflect that 12 hours; and if the graphic display is set to 30 minutes, the resulting histogram only uses those 30 minutes as the basis for its tabulations.

Histogram displays reflect only active monitoring time—non-monitoring times such as SENSOR OFF PATIENT are not reflected in the histogram displays.

To activate a histogram trend display:

1. Press the **TRND** softkey to select the trend display.
2. Move the cursor by pressing the **<-** or **->** (arrow keys) to the desired time.
3. Press the **EXPAND** softkey to select the desired trend duration.
4. Use the arrow keys to fine tune the cursor to the desired location in the trend.
5. Press the **NEXT** softkey and TREND OPTIONS are displayed.
6. Press **VIEW** and TREND VIEW is displayed.
7. Press **HIST** to display the histogram.

   The top line of the histogram display shows the start and stop dates and times (24 hour format) used to tabulate the data.

   SpO_2 data is tabulated on the left side of the display and Pulse Rate data is displayed on the right half. Data for each parameter is tabulated into six categories. Each category represents a range of possible values. For each category, a bar graph is drawn showing the percentage of the total time the parameter was within the category. To the right of the bar graphs are numerical tabulations also showing how long the parameter was within that category.

Erase Trend Memory

Trend information is retained in the monitor's memory even if the monitor is turned off and on.

Each time the monitor is turned on the message ERASE STORED TRENDS? is displayed. The user can select **YES** to erase the contents of trend memory or press **NO** to keep the previously stored trend data intact. If trend information is not erased at power up, new data will be appended to the old data already in memory. Additionally, the user can enter the trend menu and erase stored trend information.

To erase stored trend information from within the trend menus:

1. Press the **TRND** softkey to select the trend display.
2. Press the **NEXT** softkey and TREND OPTIONS are displayed.
3. Press **ERASE** and ERASE STORED TRENDS? appears.
4. Press **YES** to erase trend data or **NO** to keep trend data intact.

Trend Print

If PRINTER INTERFACE is selected in the MONITOR OPTIONS 2 portion of the menu system, a **PRNT** softkey is displayed in the TREND OPTIONS menu.

Press the **PRNT** softkey (after connecting the selected printer and readying for printing) and the displayed trend duration is graphically printed along with a histogram covering the same time frame. Refer to "Using a Printer" on page 47 for printer details.

Trend and NovaCARD Memory Module

If NOVACARD INTERFACE is selected in the MONITOR OPTIONS 2 portion of the menu system, a **CARD** softkey is displayed in the Main Menu and the TREND OPTIONS menu.

Press the **CARD** softkey (after connecting the *NovaCARD* memory module and installing a *NovaCARD*) and the NOVACARD MENU will appear. From this menu trend data can be stored to the memory card, patient identification (ID) can be entered or changed, or the *NovaCARD* can be erased.

See the "*NovaCARD* Memory Module User's Manual" for more information.

Section 9 Advanced Monitor Features

Keyclick Volume

Model 2001 responds to each key press with an audible "keyclick," a tone assuring the user that the monitor recognized a key was pressed.

To turn on or alter the keyclick volume:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 1 appears.
3. Press **KLCK** (keyclick) and SET KEYCLICK VOLUME appears.

   The current keyclick volume setting (00-07) is displayed between the up and down arrows. A 00 setting means the keyclick feature is turned off.
4. Press ↑ or ↓ to increase or decrease the keyclick volume setting.

   Each key press will cause a keyclick tone to sound.
5. Press **RUN** to return to the Main Menu.

Display Brightness

Model 2001 has two user selectable display brightness settings. To select a display brightness setting;

1. Press the **MENU** softkey and the SYSTEM OPTIONS appears.
2. Press the **LITE** softkey to switch the backlight between its bright and dim settings.
3. Press **RUN** to return to the Main Menu.

Display Colors

The default *Model 2001* display (white text on a blue background and a blue wave over a white background) can be changed. This display colors feature (coupled with the bright and dim backlight settings) allows *Model 2001* to provide a very visible display over a wide range of lighting conditions.

To change the display colors;

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 1 appears.
3. Press **DISP** (display) and the display colors change.

There are four possible display modes;

white text on blue and a blue wave on white (the default display)
blue text on white and a blue wave on white
blue text on white and a white wave on blue
white text on blue and a white wave on blue

4. When the display is as desired, press **RUN** to return to the Main Menu.

Menu System Lockout

A "Menu System Lockout" feature allows advanced users to configure the monitor's user selectable features (such as alert limits, audio features and averaging times), then activate the lockout feature to prevent those settings from being changed by less advanced or unauthorized users. Once activated, turning the monitor off and on will NOT deactivate Menu Lockout.

To activate the Menu Lockout feature:

1. Turn the monitor on and use the menus to configure the monitor as desired.
2. Turn the monitor off.
3. Simultaneously, press and hold the three leftmost softkeys. While still pressing the softkeys, press the **POWER** key. The monitor will turn on.
4. Continue holding the softkeys until a double beep sounds. Let go of the softkeys.
5. MENU IS DISABLED is displayed and Menu Lockout is active.

To cancel Menu Lockout and allow access to the menus:

1. Turn the monitor off.
2. Simultaneously press and hold the three leftmost softkeys. While still pressing the softkeys, press the **POWER** key. The monitor will turn on.
3. Continue holding the softkeys until a double beep sounds. Let go of the softkeys.
4. The **MENU** softkeys are displayed and Menu Lockout is cancelled.

Serial Output Interface

Model 2001 can communicate with other devices using the built-in RS232 compatible serial port. Several serial communications modes are available. They include:

- FULL FORMAT MODE: Default mode used for general purpose data collection.
- CHART RECORDER: Allows use of the Analog Output Module.
- 1260/1010 INTERFACE: Novametrix 1260 Capnograph or 1010 Telemetry System.
- PRINTER INTERFACE: The supported printer is the Seiko DPU-414 thermal Printer.
- NOVACOM1 INTERFACE: Designed to output data in formats easily read by a computer or data logging device.
- NOVACARD INTERFACE: Store patient trend information and waveforms into a memory card through the use of the *NovaCARD* Memory Module.

To view or alter the current serial communications mode:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 2 appears.
3. Press **SER** (serial interface) and the currently selected interface appears.
4. Repeatedly press **PREV** (previous) or **NEXT** to select the desired interface.
5. When the desired interface is displayed, press **SET**.

   If Full Format or Printer Interface modes are selected, additional menu choices will be presented. Refer to the following sections for details.
6. The MONITOR OPTIONS 2 menu appears. Press **RUN** to return to the Main Menu.

Full Format Mode

Full Format Mode allows for data communication from the *Model 2001* to a device such as a personal computer or data logging system fitted with an RS232 interface.

Full Format Mode is *Model 2001*'s factory default serial interface. The default parameters are; 9600 baud, no parity, 8 data bits, and 1 stop bit.

An interface cable from the *Model 2001* with transmit (pin-3) and ground (pin-7) is used to perform the data link. Handshake lines (pins 6 and 20) should be connected together at the *Model 2001* end of the cable.

An ASCII string consisting of the following characters is transmitted once each second;

```
: SpO2 = aaa  Rate = bbb  Status : ccccccccccccccccccc <CR><LF>
```

Where `aaa` and `bbb` are the values on the monitor's displays, and where the status section (`ccc`...) will display any message (20 character max) as shown in the Message Center (this section is padded with blank spaces if no messages are shown). `<CR><LF>` is a carriage return and line feed sequence.

Chart Recorder Mode

Selecting Chart Recorder Mode allows the *Model 2001* to communicate with the Novametrix Analog Output Module. See "Analog Output Module" on page 55 for more information.

1260/1010 Interface Mode

Selecting 1260/1010 Interface Mode allows the *Model 2001* to communicate with a Novametrix Model 1260 Capnograph monitor using the Novametrix interface cable Catalog No. 5134-00, or to communicate with the Novametrix Model 1010 Central (Telemetry) Station via a Model 101 Telemetry Transmitter attached to the rear panel of the *Model 2001*. Refer to the Model 1260 or 1010 documentation for further details.

Printer Interface Mode

The Printer Interface Mode directly supports the Seiko DPU-414 Thermal Printer. When this mode is selected, a **PRNT** (print) softkey is added to the Main Menu and to the Trend Options menu.

Refer to "Using a Printer" on page 47 for specific printer setup and use instructions.

NOVACOM1 Interface Mode

The *NOVACOM1* interface is designed to output data in formats easily read by a computer or data logging device. The computer interface provides the user several communication modes to choose from. The communication format is 9600 baud, 8 bits, no parity, 1 stop bit and XON/XOFF handshaking.

Mode 1 — Real Time

In Real Time mode, the saturation values, and respiration rate are continually transmitted at one second intervals.

To enter Real Time mode, the computer must send an ACSII "1" character. The *Model 2001* will echo back the "1" followed by a <cr><lf>, and enable real time communication. The data format is:

MS***P***Z**<cr><lf>

where;
M - Event Marker identifier, "M"= event marked, "-"= no event,
S - an identifier for a 3-digit ASCII SpO_2 value to follow, (0-100)
P - an identifier for a 3-digit ASCII Pulse value to follow, (0-250)
Z - an identifier for a 2-digit ASCII SpO_2 status (message) value
*** - a 3-digit ASCII value,
** - a 2-digit ASCII value,
<cr><lf> - a carriage return, line-feed sequence.

The Z** (SpO_2) values correspond to *Model 2001* display messages. The messages corresponding to the displayed numbers are shown below.

Table 1.NOVACOM1 message decode

Z** where ** is:	SpO_2 messages
00	No error
01	N/A
02	SpO_2 Low Signal
03	SpO_2 Insuf Light
04	Pulse Out of Range
05	N/A
06	SpO_2 Light Interf
07	N/A
08	SpO_2 Probe Off Patient
09	Connect SpO_2 Probe
10	Incomp SpO_2 Probe
11	Can't ID SpO_2 Probe
12	SpO_2 Faulty Probe Ir
13	SpO_2 Faulty Probe Rd
14	SpO_2 Faulty Probe
15	N/A
16	SpO_2 Hardware Err
17	SpO_2 Bad Signal

To exit Real Time mode, the computer must send an "x" or "X" character. The *Model 2001* will echo the "x" and then stop real time communication.

Mode 4 — SpO_2 Waveform

In SpO_2 Waveform mode, the saturation, pulse rate, and SpO_2 display messages, are continually transmitted at one second intervals. Plethysmogram waveform data is also continually transmitted 50 times a second.

To enter SpO_2 Waveform mode, the computer must send an ASCII "4" character. The *Model 2001* will echo the "4" followed by a <cr><lf> and then enable communication.
The data format is:

MS***P***Z**<cr><lf> (sent once a second)
p++<cr><lf> (sent 50 times a second)

where;
M - Event Marker identifier, "M"= event marked, "-"= no event,
S - an identifier for a 3-digit ASCII SpO_2 value to follow,
P - an identifier for a 3-digit ASCII Pulse rate value to follow,
Z - an identifier for a 2-digit ASCII SpO_2 status value
*** - a 3-digit ASCII value,
** - a 2-digit ASCII value,
p - an identifier for a 2-digit waveform data point to follow,
++ - a 2-digit ASCII value (in the range 0-99),
<cr><lf> is a carriage return, line-feed sequence.

The Z** (SpO_2-message) value represents the current status of the parameter. A value of "00" is returned if no error is active. Refer to "Mode 1 — Real Time" on page 42 for a complete list of error messages.

To exit SpO_2 Waveform mode, the computer must send an ASCII "x" or "X" character. The *Model 2001* will echo "x" and stop communication.

Mode 6 — Trend Dump

Trend data is transmitted as a succession of records. The record size for *Model 2001* is 16 bytes of ASCII Hexadecimal data. A record can be one of two types, an INFO record or a DATA record. The INFO record contains monitor information such as time of day, date, limit settings, and units. The DATA record contains event marker, audio disable, SpO_2, and pulse rate values.

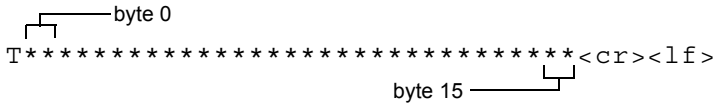
The first record sent is always an INFO record. This record reflects the oldest data in the buffer, then records would continue being sent in chronological order from the oldest record to the newest record. In normal monitoring use, an INFO record would be followed by 15 data records, followed by another INFO record and then another 15 data records, etc. Turning the monitor off, or changing the limits will disrupt this sequence. When this occurs a new INFO record will be sent and indicate the time and date, along with the current limits. At this point, unless another exception occurs, the next INFO record will be followed by 15 DATA records.

An INFO record can be distinguished from a DATA record by the first byte of the record. The first byte of an INFO record is FF, the first byte of a DATA record is 00-C8 (0-200 decimal), or FB (pen lift or no data available). Any other values are not applicable. The DATA record uses 8 data points per parameter, at 8 second resolution, for a total of 64 seconds of trend data per data record.

To request trend dump, the computer must send an ASCII "6" character. The monitor echoes back the "6" character and transmits the first INFO record.

The Mode 6 data format is:

INFO record;



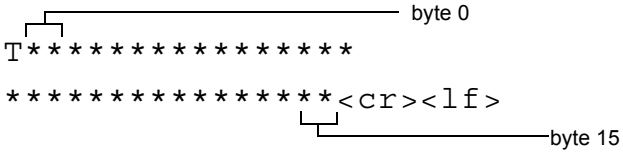
where;
T- Trend mode identifier
**-INFO byte, starting at byte 0 and ending at byte 15 (see below)

Table 2.INFO record byte assignment

byte -0	flag byte = FF for INFO record
byte-1	information type (FE-power on, FD-limit change, FC-time stamp)
byte-2	model code = 2
byte-3	compression ratio = 8 (i.e. 1 point/8 seconds)
byte-4	seconds (0-59)
byte-5	minute (0-59)
byte-6	hour (0-23)
byte-7	day (1-31)
byte-8	month (1-12)
byte-9	year (0-99)
byte-10	SpO_2 limit, high
byte-11	SpO_2 limit, low
byte-12	Heart Rate limit, high
byte-13	Heart Rate limit, low
byte-14	unused
byte-15	unused

<cr> - carriage return
<lf> - line feed

DATA record;



T - Trend mode identifier
**-DATA byte, starting at byte 0 and ending at byte 39 (see below)

Table 3.DATA record byte assignments

byte 0-7	8 byte SpO_2 data, range: 01-28 Hex (1-40 decimal) (corresponds to 60-100%, i.e. a value of 1E Hex that corresponds to 30 decimal will indicate an SpO_2 value of 90%), 00-no data available. EVENT marker on if MSB is set. AUDIO off is 2nd MSB is set.
byte 8-15	8 byte pulse rate data, range: 00-FA Hex (0-250 decimal), FB Hex (251 decimal) - no data available over period.

<cr> - carriage return
<lf> - line feed

Mode d — Date and Time

Date and Time mode causes the *Model 2001* to transmit, on request, the date and time as calculated by the monitor's internal calendar clock.

To request the date and time, the computer must send an ASCII "d" character. The monitor echoes back the "d" character and sends the date and time on the same line. The Mode d data format is:

d•MMM/DD/YY•hh:mm:ss<cr><lf>

where;
d - the echoed command character
• - is an ASCII space character
MMM - a 3-character month (Jan, Dec),
DD - a 2-digit ASCII day (01, 31),
YY - the last 2-digits of the year (1990 is 90),
hh - a 2-digit hour based on a 24 hour clock (00, 23),
mm - a 2-digit minute,
ss - a 2-digit second,
<cr><lf> is a carriage return, line-feed sequence.

Mode c — Clear Trends

Clear Trends mode allows the user to remotely clear the *Model 2001* trend memory This action has the same result as the monitor's Clear Trend function in that trend memory and the Trend Page displays are cleared.

Use this remote Clear Trends function with care as there is no way to undo the clear command once issued.

To clear the *Model 2001* trend memory, the computer must send an ASCII "c" character. The *Model 2001* will echo the "c" followed by a <cr><lf> and then the trend memory will be cleared.

NovaCARD Interface Mode

The *Model 2001* can store patient trend information and waveforms into a memory card through the use of the *NovaCARD* Memory Module. The *NovaCARD* Memory Module connects to *Model 2001*'s rear panel RS232 connector (See "Serial Output Interface" on page 40). The information stored in the memory card can then be read by a computer using the *NovaCARD* Reader. For more information on the *NovaCARD* Memory Module, reference the *NovaCARD* Memory Module Operator's Manual (Cat. No. 5962-23). For more information on the *NovaCARD* Reader, reference the *NovaCARD* Reader Operator's Manual (Cat No. 6062-23).

When NOVACARD INTERFACE is selected, a **CARD** softkey is added to the SYSTEM OPTIONS menu. A STORE WAVEFORM TO CARD? prompt appears when the **EVENT** key is pressed and the waveform is frozen.

Setting the Clock/Calendar

Model 2001 contains a clock/calendar feature that operates even when the monitor is turned off. This feature allows *Model 2001* to "time stamp" trend data as well as data that is output to external devices such as printers.

Unlike other monitor settings, the clock/calendar is not reset by the power-up-with-Alert-Reset-key feature. The clock/calendar must be reset manually.

To view/alter the current time and date setting:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 2 appears.
3. Press **CLOCK** and the clock/calendar setup menu appears.
   The current hour setting is highlighted by flashing.
4. Each press of the **SEL** (select) key selects a new item to highlight.
5. Press ↑ or ↓ to increase or decrease the setting of the highlighted item.
6. When the time and date are correct, press **SET**. MONITOR OPTIONS 2 appears.
7. Press **RUN** to return to the Main Menu.

Display Monitor Software Revision Level

To check the revision level and date of the system software installed in the *Model 2001*:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 1 appears.
3. Press the **VER** (version) softkey. The software version number appears.
4. Press the **NEXT** softkey. The date of the software version appears.
5. Press the **NEXT** softkey and MONITOR OPTIONS 1 appears.
6. Press **RUN** to return to the Main Menu.

Section 10 Using a Printer

The *Model 2001* Pulse Oximeter directly supports an RS232 serial printer,* the Seiko DPU-414 Thermal Printer (PN: 9140-00).

Selecting the Printer Interface

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 2 appears.
3. Press **SER** (serial interface) and the currently selected interface appears.
4. Press **PREV** (previous) or **NEXT** to select PRINTER INTERFACE.
5. Press **SET**. MONITOR OPTIONS 2 appears.
6. Press **RUN** to return to the Main Menu.

   When the Printer Interface Mode is selected, a **PRNT** (print) softkey is added to the Main Menu and to the TREND OPTIONS menu.

Connecting the Seiko DPU-414 Thermal Printer

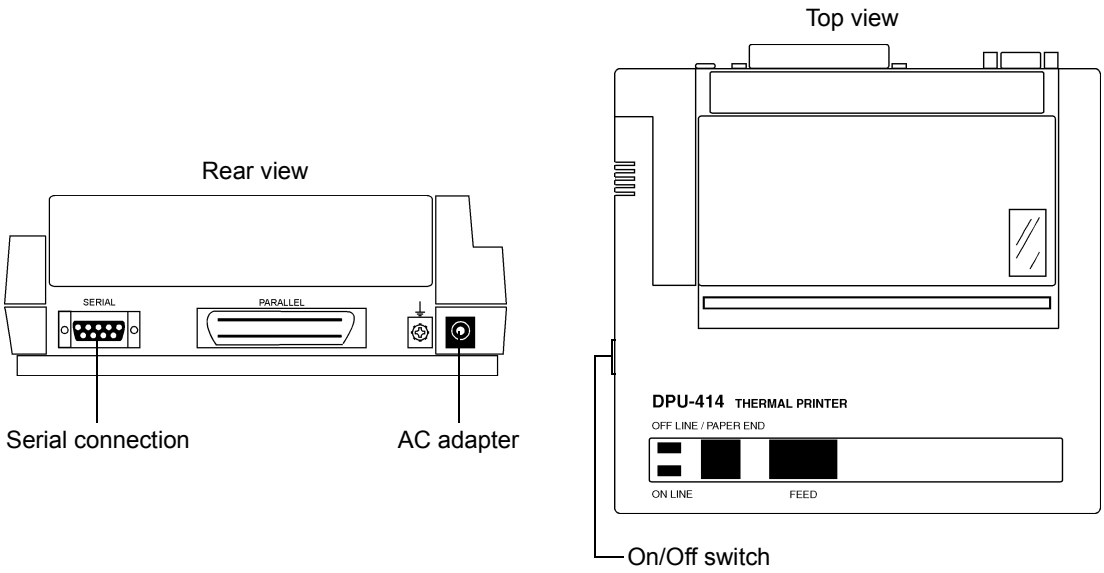
To connect the Seiko DPU-414 Thermal Printer to the *Model 2001*:

1. Connect the 9085-00 interface cable to the monitor‘s RS232 connector and to the printer’s serial input connector—the 9 pin D connector.
2. Connect the AC adapter and turn the printer on.

*. See “Analog Output Module” on page 55, for details on connecting analog type printers and recorders.

Configuring the Seiko DPU-414 Thermal Printer

The Seiko DPU-414 Thermal Printer (Cat. No. 9140-00) must be configured to communicate with the *Model 2001*. When properly configured, the Seiko printer will retain the settings, even when turned off.



1. Slide the printer's power switch to OFF "O".
2. Press and hold the **ON LINE** button, then slide the power switch ON "I". Release the **ON LINE** button after the list of current settings starts printing out.

Setting the DIP switches:

3. The printout of the current settings is followed by the prompt:

   "Continue? : Push On-line SW"
   "Write? : Push Paper feed SW"

   To change the DIP switch settings, push the **ON LINE** button (to leave the DIP switch settings unchanged, push the **FEED** button).

4. "DIP SW-1" will print. Enter the new settings for switches 1-8.

   "ON" is set by pushing the **ON LINE** button once
   "OFF" is set by pushing the **FEED** button once

   The printer will confirm each selection. Repeat for DIP SW 2 and 3.

The DIP switch settings for the *Model 2001* are as follows:

```
[ DIP SW settings mode ]

Dip SW-1

    1 (OFF) : Input = Serial
    2 (ON ) : Printing Speed = High
    3 (ON ) : Auto Loading = ON
    4 (OFF) : Auto LF = OFF
    5 (ON ) : Setting Command = Enable
    6 (OFF) : Printing
    7 (ON ) :   Density
    8 (ON ) :   = 100 %

Dip SW-2

    1 (ON ) : Printing Columns = 40
    2 (ON ) : User Font Back-up = ON
    3 (ON ) : Character Select = Normal
    4 (ON ) : Zero = Normal
    5 (ON ) : International
    6 (ON ) :   Character
    7 (ON ) :   Set
    8 (OFF) :   = U.S.A.

Dip SW-3

    1 (ON ) : Data Length = 8 bits
    2 (ON ) : Data Parity = No
    3 (ON ) : Parity Condition = Odd
    4 (ON ) : Busy Control = H/W Busy
    5 (OFF) : Baud
    6 (ON ) :   Rate
    7 (ON ) :   Select
    8 (ON ) :   = 9600 bps

Continue ? : Push 'On-line SW'
Write ?    : Push 'Paper feed SW'
```

CAUTION: DIP SW Set Mode cannot be cancelled once it is initiated. Answer "ON" or "OFF" for every setting.

Note: More information about DIP switch settings can be found in the Seiko "DPU-414 Thermal Printer Operation Manual."

5. When the printer finishes writing the new settings to memory, "DIP SW setting complete!!" is printed out and the printer returns to ON LINE mode.

CAUTION: Never turn the printer off while it is writing the new settings to memory. Wait until "DIP SW setting complete!!" is printed, then the printer power may be turned off.

Print Formats

The following print types are available:

- Displayed Trend Printout
- Tabular Mode Text Printout
- Plethysmogram Waveform Printout
- Zoom Trend Printout
- Compressed Trend Printout

Displayed Trend Printout

To create a Displayed Trend Printout from the graphical or histogram trend display:

1. Ensure the selected printer is connected and ready to print.
2. Press the **TRND** softkey to display trend data.
3. Press **EXPAND** to select the 12 hour, 8 hour, 2 hour, or 30 minute trend display.

   The start and stop times for the printed graph and histogram are approximately the same (due to compression) as those displayed on the monitor trend display when the printout is initiated.
4. Press the **NEXT** softkey. TREND OPTIONS appears.
5. Press **PRNT**. PRINTOUT STARTED is displayed and printing starts.

   The user can also press **PRNT** in the histogram display—the printout will be the same.

   The printer stops automatically when the printout is complete.

   If **PRNT** is pressed again before the printout finishes, PRINT IN PROGRESS appears. Press **STOP** to terminate printing, or press **CONT** (continue) to resume printing.
6. TREND OPTIONS reappears. Press **RUN** to return to the Main Menu.

Tabular Mode Text Printout

To start a Tabular Mode Printout:

1. Ensure the selected printer is connected and ready to print.
2. Press the **PRNT** softkey. SELECT PRINT OPTIONS appears.
3. Press **TAB**. PRINTOUT STARTED is displayed and printing starts.

To stop a Tabular Mode Printout:

1. Press the **PRNT** softkey. PRINT IN PROGRESS appears.
2. Press **STOP** to stop the printout.

   Or, press **CONT** to continue with the Tabular Mode Text Printout.

Plethysmogram Waveform Printout

To start a Plethysmogram Waveform Printout:

1. Ensure the selected printer is connected and ready to print.
2. Press the **PRNT** softkey. SELECT PRINT OPTIONS appears.
3. Press **WAVE**. PRINTOUT STARTED is displayed and printing starts.

   The printer stops automatically when the printout is complete.

   If **PRNT** is pressed again before the printout finishes, PRINT IN PROGRESS appears. Press **STOP** to terminate printing, or press **CONT** (continue) to resume printing.

Zoom Trend Printout

To create a Zoom Trend Printout:

1. Ensure the selected printer is connected and ready to print.
2. Press the **PRNT** softkey. SELECT PRINT OPTIONS appears.
3. Press **TRND**. PRINT TREND appears.
4. Press **PART**. The SET START time menu appears.
5. Press ↑ or ↓ to select the point (time) in trend memory to start the printout.
6. Press **ENTER**. The SET STOP time menu appears.

   Or, press **RESET** to reset the start time to the beginning of trend memory.
7. Press ↑ or ↓ to select the point (time) in trend memory to stop the printout.
8. Press **PRINT**.

   Or, press **RESET** to set the stop time to the end of trend memory.
9. PRINTOUT STARTED is displayed and printing starts.

   The printer stops automatically when the printout is complete.

   If **PRNT** is pressed again before the printout finishes, PRINT IN PROGRESS appears. Press **STOP** to terminate printing, or press **CONT** (continue) to resume printing.

Compressed Trend Printout

To create a Compressed Trend Printout:

1. Ensure the selected printer is connected and ready to print.
2. Press the **PRNT** softkey. SELECT PRINT OPTIONS appears.
3. Press **TRND**. PRINT TREND appears.
4. Press **ALL**. SELECT PRINT COMPRESSION appears.
5. Select **NONE**, **1/2**, **1/4** or **PAGE**.

   NONE. Printout length of up to 12 sheets of paper (standard 8.5 x 11 inch sheets)
   1/2. Printout length of up to 6 sheets of paper
   1/4. Printout length of up to 3 sheets of paper
   PAGE. Printout sized to fit a single sheet of paper.

6. PRINTOUT STARTED is displayed and printing starts.

   The printer stops automatically when the printout is complete.

   If **PRNT** is pressed again before the printout finishes, PRINT IN PROGRESS appears. Press **STOP** to terminate printing, or press **CONT** (continue) to resume printing.

Interpreting Printer Output

Header

Each printout starts with a header that identifies the oximeter (*Model 2001*) and printer type. The date and time of the printout is furnished by the monitor's calendar/clock. Space is then provided to enter patient information. The type of printout (Zoom Compressed, etc.) is then identified.

Graphical Data

A graphical depiction of trend memory is printed after the header for all printouts except the tabular and waveform modes.

Column A and B Information: The next two lines refer to Columns A and B in the printout. Column A represents the monitor's audible alarm status. A mark (black bar) in this column indicates that the audible alarms were silenced during this portion of the printout. Column B shows marks where "Events" were added to trend memory.

Data Scales: The Pulse Rate and Oxygen Saturation scales are printed and dotted lines within the data section correspond to the major divisions shown on the scale lines.

Data Ratio: The line following the data scales shows the date the recording was initiated and the data ratio. The data compression ratio depends on the type of printout selected. For example, one dot on the printout may correspond to 8 or 64 seconds.

Alert Limit Settings: Following the data ratio and just before the actual data, are the alert limit settings. Both the pulse rate and saturation scales have two triangle-shaped markers that represent the upper and lower alert limit settings as shown on the monitor's display. Dashed lines extend from these markers down into the data section of the printout. If the alert limits were changed during the time the printed data was originally collected, the new alert limits will be printed with a message indicating that the limits were changed.

Data Section: The data is printed based on the ratio. A time stamp is placed at regular intervals and appears as a horizontal line printed between the scales.

Histogram Data

A histogram based on the printed portion of trend memory is printed after the graphical data for all trend printouts.

Total Elapsed Time. Time trending was active; the total time covered by the printout.

Non-Monitoring Time. Time spent in a Sensor Off Patient, Connect SpO_2 Sensor or other non-monitoring condition.

Limit Alert Status. Percent of monitoring time spent above, below and within the parameter alert limits as shown on the printout.

Histogram Data. A numerical and graphical display of the percentage of monitoring time (non-monitoring time excluded) spent in each of the saturation ranges listed. Note that some time, but less than one percent of the total time, can be spent in any category.

Average, Min and Max. The minimum and maximum recorded SpO_2 and Pulse Rate values are recorded. Average refers to the most often recorded value and not the mathematical mean of all readings.

End of Trend Printout. Message shows Histogram is a part of the Print Trend feature.

Tabular Data Format

Tabular Mode Text Printouts start off with a header (refer to previous section), followed by one line of text printed at 30 seconds intervals.

The format of the tabular text line is "HH:MM:SS SPO2 = XXX % PULSE = YYY bpm", where HH:MM:SS is the hour, minute and seconds (24 hour format), XXX is the displayed saturation value, and YYY is the displayed pulse rate.

Plethysmogram Waveform Format

Plethysmogram Waveform Printouts start off with a header (refer to previous section), followed by graphical depiction of the last 5 seconds of plethysmogram data.

The printout represents the five seconds of plethysmogram data immediately prior to when the **WAVE** softkey was pressed. Graphically, the **WAVE** softkey press corresponds to the bottom of the printout; the top of the printout is five seconds before **WAVE** was pressed.

The SpO_2, Pulse Rate and time values that are printed reflect the displayed values at the time the **WAVE** softkey was pressed.

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Section 11 Analog Output Module

Model 2001's optional Analog Output Module, PN: 5963-00, provides the necessary analog output voltages for use with analog instruments such as strip chart recorders. *Model 2001* does not directly support analog devices.

The Analog Output Module attaches to the *Model 2001* and provides analog output voltages, via a 15-pin connector. See "Serial Output Interface" on page 40, to configure the *Model 2001* to use the Analog Outout Module.

Connecting the Analog Output Module

Two screws, supplied with the module, are passed through the module and screw into the pre-tapped holes in the *Model 2001* rear panel to secure the Analog Output Module in place.

1. Connect the Analog Output Module to the monitor's rear panel RS232 connector.
2. Tighten the two spring-loaded screws that secure the Analog Module to the rear panel.
3. Connect the interface cable to the Analog Module's 15-pin connector.

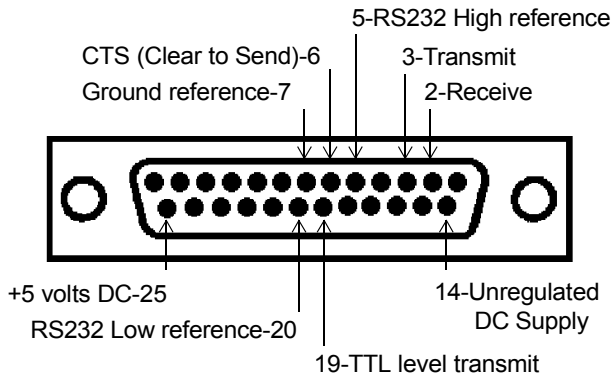
   The Interface Cable, PN: 6045-00, connects to the 15-pin D connector on the Analog Module then terminates to six twisted pair wires. The six twisted pair wires on the open end of the interface cable correspond to channels 0-5 as listed below. Connect these wires to the analog recorder.

Channel	Parameter	Pin No.	Wire Pair	Specifications
0	n/a	n/a	n/a	n/a
1	n/a	n/a	n/a	n/a
2	n/a	n/a	n/a	n/a
3	Saturation Value	7	Orange/White	10mv=1%
4	Heart Rate	9	Yellow/White	4mv=beat/min
5	Plethysmogram	11	Green/White	not scaled (1v max)
-	Alert Output	15	-	active low

The white wire on all twisted pairs is the reference (ground).

Rear Panel RS232C Pinout

The *Model 2001* rear panel RS232C connector's pinout is illustrated below.



Analog Output Setup

A CALIBRATE RECORDER menu within the *Model 2001* software allows the user to easily calibrate analog recorders to the voltage levels produced by the Analog Output Module. To access this feature, the monitor must be configured for a CHART RECORDER.

To configure the monitor:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 2 appears.
3. Press **SER** (serial) and the currently selected serial device appears.
4. Repeatedly press the **NEXT** softkey until CHART RECORDER appears. Press the **SET** key.
5. MONITOR OPTIONS 2 appears. Press **REC** and continue at step 3 (below), or press **RUN** to return to the Main Menu.

To calibrate the chart recorder:

1. Press and hold the **MENU** softkey for 3 seconds. SPO2 SETUP OPTIONS is displayed.
2. Repeatedly press the **NEXT** softkey until MONITOR OPTIONS 2 appears.
3. Press **REC** (recorder) and CALIBRATE RECORDER appears.
4. Press **ZERO**, **HALF** and **FULL** to set the analog outputs.

   ZERO — SpO_2: 0% = 0 volts, Pulse Rate: 0 bpm = 0 volts, pleth: 0 volts
   HALF — SpO_2: 50% = 0.50 volts, Pulse Rate: 125 bpm = 0.50 volts, pleth: 0.50 volts
   FULL — SpO_2: 100% = 1.00 volts, Pulse Rate: 250 bpm = 1.00 volts, pleth: 1.00 volts
5. Once the recorder is calibrated, press **RUN** to return to the Main Menu.

   This setup procedure does not have to be performed each time the monitor is turned on—the monitor will always automatically output analog information via the Analog Output Module. This procedure simply helps calibrate the recorder to the *Model 2001* signals.

Section 12 Maintenance

The *Model 2001* performs a diagnostic self-test at power up that checks the internal electronics. If this self-test fails, the normal monitoring display will not appear. Remove the oximeter from use and contact qualified service personnel.

The oximeter should undergo inspection and safety checks on a regular basis or acording to institutional protocol. A Service Manual (Catalog No. 9400-90) containing information to assist qualified service personnel is available.

Cleaning and Sterilization

Follow the cleaning and sterilization instructions listed below to clean and/or sterilize the *Model 2001* and its accessories.

Model 2001 Monitor

- Turn the monitor off and unplug the line cord from the AC power source before cleaning.
- The monitor can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% gluteraldehyde, or 10% bleach solution. Wipe down with a water dampened clean cloth to rinse. Dry before use.
- Do not immerse the monitor.
- Do not attempt to sterilize the monitor.

SpO_2 Finger Sensor

- The sensor can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% gluteraldehyde, or 10% bleach solution. Wipe down with a water dampened clean cloth to rinse. Dry before use.
- Make certain that the finger sensor window is clean and dry before reuse.
- Do not immerse the finger sensor.
- Do not attempt to sterilize the finger sensor.
- After cleaning the finger sensor, verify that the sensor is physically intact, with no broken or frayed wires or damaged parts. Make certain that the connectors are clean and dry, with no signs of contamination or corrosion. Do not use a broken or damaged sensor or one with wet, contaminated or corroded connectors.
- Perform a “Quick Check” to verify the integrity of the sensor (See “Finger Sensor Quick Check” on page 21).

SpO_2 Y-Sensor

- Do not immerse connector on the Y-Sensor.
- The Y-Sensor may be immersed—up to, but not including, the connector, in a 2% gluteraldehyde solution, or 10% bleach solution. Refer to manufacturer's instructions and standard hospital protocols to determine recommended times for disinfection and sterilization.
- Rinse thoroughly with water and dry before use (do not rinse the connector).
- Do not attempt to sterilize Y-Sensor except as stated above.
- After cleaning or sterilizing the Y-Sensor, verify that the sensor is physically intact, with no broken or frayed wires or damaged parts. Make certain that the connectors are clean and dry, with no signs of contamination or corrosion. Do not use a broken or damaged sensor or one with wet, contaminated, or corroded connectors.
- Perform a "Quick Check" to verify the integrity of the sensor (See "Y-Sensor Quick Check" on page 27).

SpO_2 Tapes and Foam Wraps

- Treat Y-Strip Tapes and foam wraps in accordance with hospital protocol for single-patient use items.

Ear Clip

- Clean the ear clip with a cloth dampened with 70% isopropyl alcohol. After cleaning, thoroughly wipe the ear clip with a clean water-dampened cloth.

Mains Voltage Configuration

The rear panel power entry module indicates the mains voltage setting for the monitor. Check that the voltage is correct before attaching the AC line cord and powering the monitor. The *Model 2001* can be set to operate from 100-120 VAC 50/60Hz or 200-240VAC 50/60Hz.

Instructions for fuse replacement and changing the mains voltage setting follow.

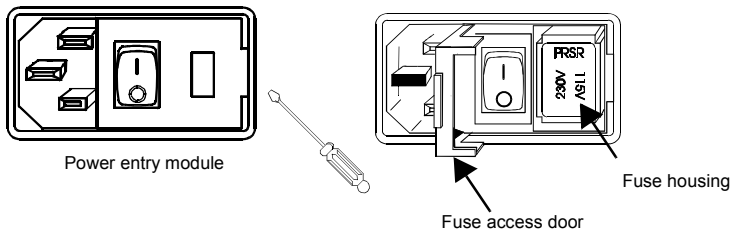
CAUTION: Replace fuses with same type and rating. Verify proper fuse value for mains voltage setting (see table below).

Fuse Replacement

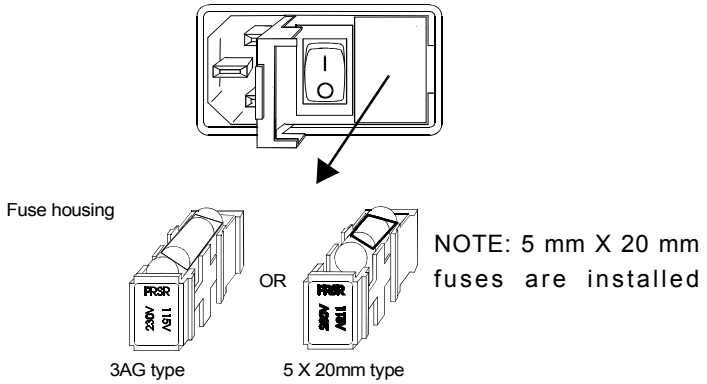
1. Check that the monitor is OFF.
2. Set the rear panel power entry module switch to OFF ("O"). Remove the AC line cord from the power entry module.

3. Using a flat blade screwdriver, pry the fuse access door open to expose the fuse housing. Note the orientation of the fuse housing (this determines the mains operating voltage).

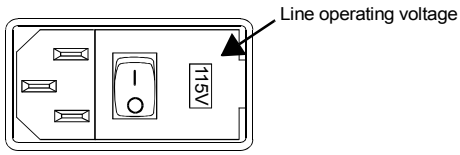
Mains Voltage	Fuses (Slo Blo)
100-120 VAC	0.5 A 250V
200-240 VAC	250mA 250V



4. Pry the fuse housing out from the power entry module.



5. Replace the blown fuse(s) with the proper type and rating.
6. Reinstall the fuse housing. When positioning the housing into the power entry module make sure that it is oriented correctly. Press the fuse housing back into the power entry module.
7. Close the fuse access door and verify that the proper mains operating voltage is displayed.



Changing the Mains Voltage Setting

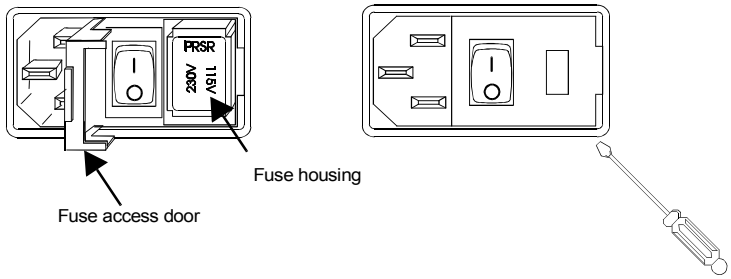
1. Check that the monitor is OFF.

2. Set the rear panel power entry module switch to OFF ("O"). Remove the line cord from the power entry module.

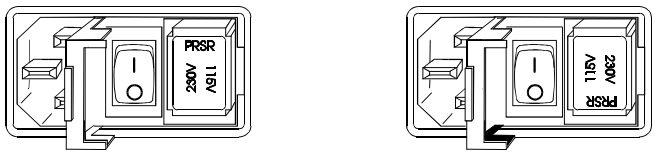
CAUTION: Replace fuses with same type and rating. Verify proper fuse value for mains voltage setting (see table below).

Mains Voltage	Fuses (Slo Blo)
100-120 VAC	0.5 A 250V
200-240 VAC	250mA 250V

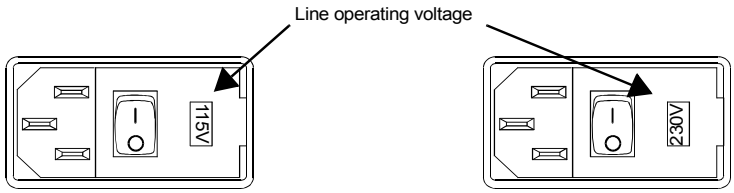
3. Using a flat blade screwdriver, pry the fuse access door open to expose the fuse housing. Pry the fuse housing out from the power entry module.



4. Install the proper type and rating fuse for the mains voltage setting required.
5. Position the housing into the power entry module so that the desired voltage is furthest away from the switch (see below).



6. Close the fuse access door and verify that the proper mains operating voltage is displayed.



Section 13 Specifications

General

Specifications for the Novametrix *Model 2001* Pulse Oximeter, are listed for informational purposes only, and are subject to change without notice.

Oxygen Saturation (SpO_2) Section

- Range: 0-100%
- Accuracy: 70-100% ± 2% (1 standard deviation), 0-69% unspecified
  (Approximately 68% of the observations are within the accuracy claim.)
- Display Resolution: 1%
- Averaging Time: fixed at 8 seconds
- Audible SpO_2 Trend Feature:
  Pitch of (user selectable) Pulse Rate "beep" tracks the SpO_2 value (i.e., decreasing SpO_2 values are signalled by lower pitched "beeps").
- Settling Time:
  Display settles to within 1% of the final reading less than 15 seconds after the sensor is properly applied.
- Alerts:
  Continuously displayed. Menu selectable high and low limits (100-50). Visible alarm is immediate. Audible alarm occurs after 10 seconds of continuous violation of the set limit, or immediately. Limit values are retained in memory when monitor is turned off, or the monitor can be set to use its default settings each time it is turned on.

Pulse Rate Section

- Range: 30-250 beats per minute (bpm)
- Accuracy: ± 1% of full scale (1 standard deviation)
  (Approximately 68% of the observations are within the accuracy claim.)
- Display Resolution: 1 bpm
- Averaging Time: fixed at 8 seconds
- Settling Time:
  Display settles to within 1% of the final reading less than 15 seconds after the sensor is properly applied.
- Alerts:
  Continuously displayed. Menu selectable high and low limits (249-30 or Off). Visible alarm is immediate. Audible alarm occurs after 10 seconds of continuous violation of the set limit or immediately. Limit values are retained in memory when monitor is turned off, or the monitor can be set to use its default settings each time it is turned on.

General Specifications

- Operating Conditions:
  50-104° F (10-40 °C), 0-90% relative humidity, non-condensing
- Transport/Storage Conditions:
  -10 to +55°C (14-131°F), 10-95% relative humidity, non-condensing
- Weight: 7 lbs 5 oz. (3.32 kg)
- Dimensions:
  Height, 3.3 inches (8.38 cm) Width, 9 inches (22.86 cm) Depth, 8 inches (20.32 cm)
- Power: 100-120/200-240 VAC, 50/60 Hz
- Fuse Rating:
  U.S.A.: 0.5 A, 250 V, Slo-Blo (x2) European: T 250 mA/250 V (x2)
- Battery:
  Type, lead-acid gel-cell. Battery Life, 3 hours.
  Note: Excessive alerting reduces battery life. When 15 minutes of battery life remain, the (low battery) indicator illuminates. When the battery becomes exhausted, the monitor display shuts down. Connect to AC power to recharge battery. Recharge Time, battery fully recharged in 12-15 hours maximum.

Additional Features

- 2 Minute Silence:
  When **AUDIO** key is pressed, deactivates audible alerts for two minutes.
  Indicated by illuminated (2 Min LED).
- Audio Off:
  Feature user selectable. If enabled, press and hold **AUDIO** key for 3 seconds, and audible alarms will not activate.
  Indicated by flashing (OFF LED).
- Battery Backed Trend Memory:
  Trend memory print of any 30 minutes, 2 hours, 8 hours 12 hours or 24 hours when used with the Seiko DPU-414 Thermal Printer.
- Analog (Recorder) Output Module - Optional:
  Provides analog output for strip chart applications at the following levels:
  Oxygen Saturation value, 10mV/% (100% = 1 V)
  Pulse Rate value, 4mV/bpm (250 bpm = 1 V)
  Plethysmograph pulse waveform, 0-1V max (AGC)
- Serial (RS232) Data Output:
  Provides RS232 data interface compatible with;
  Seiko DPU-414 Thermal Printer
  Novametrix Model 1260 Capnograph
  Novametrix Model 1010 Telemetry Central Station
  RS232 computer interface
  NovaCARD Memory Module
  NOVACOM1 Interface
- Internal Real Time Clock
- Alert Bar

Section 14 *Accessories*

Model 2001 Pulse Oximeter

Catalog No.	Description
9400-00	***Model 2001 Pulse Oximeter*,** with choice of sensor
	Oxy*Snap*™ SpO_2 SENSORS and CABLES
8793-00	**Oxy*Snap* Y-Sensor** (use with Oxy*Snap* Extension Cable)
8744-00	**Oxy*Snap* Finger Sensor** (use with Oxy*Snap* Extension Cable)
8853-00	**Oxy*Snap* Extension Cable**, 8 ft. (use with Oxy*Snap* sensors)
8898-00	**Oxy*Snap* Long Extension Cable**, 12 ft. (use with Oxy*Snap* sensors)
4941-00	**Saturatio**n Sensor Ex**tension Cable**—4 feet
4942-00	**Saturatio**n Sensor **Extension Cable**—6 feet
4943-00	**Saturatio**n Sensor E**xtension Cable**—10 feet
6147-00	**Saturatio**n Sensor Ex**tension Cable**—50 feet
5266-00	**Saturati**on Sensor Ex**tension Cable**—25 feet
8776-00	**SuperBright™ Finge**r Sensor (10 ft sensor cable)
8791-00	**SuperBright™ Y-Sensor** (10 ft sensor cable)
8789-00	**Special Use SuperBright™ Finge**r Sensor (8 inch sensor cable)
5238-00	**Special Use SuperBright™ Finge**r Sensor & 25 ft. shielded cable
	SINGLE PATIENT USE SpO_2 SENSOR
6455-00	**Single Patient Use Pediatric/Adult Sensor (10 p**er box)
6455-25	**Single Patient Use Pediatric/Adult Sensor (25 p**er box)
6480-00	**Single Patient Use Neonatal/Pediatric Sensor (10 pe**r box)
6480-25	**Single Patient Use Neonatal/Pediatric Sensor (25** per box)
8933-00	**Cable, DB-9 Extension Cable**
8936-00	**DB-9 to Oxy*Snap* Jumper Cable**

Catalog No.	Description

SENSOR MANAGEMENT PLANS

Select a Finger or Y-Sensor Plan for each Pulse Oximeter. The plan you select determines the length of coverage—12, 24 or 36 months.

How the Plans Work: Included in each Plan are TWO sensors—one for immediate use, the other one for back-up. If a sensor becomes inoperative, place the back-up sensor into use and return the inoperative sensor in the convenient pre-paid mailer. A replacement sensor will be shipped within two business days of receipt of the inoperative sensor. This simple return/replacement method will be used for the entire warranty period, thereby guaranteeing your costs and virtually eliminating sensor tracking hassles.

Warranty: For each Pulse Oximeter a plan is purchased for, the warranty on the monitor is also extended to the length of the plan. Replacement sensors provided under terms of the Plan shall carry the remaining Plan warranty—replacements do not extend the warranty.

8793-12	**Y-12 Plan** The Plan warranty is 12 months. Includes 3 boxes (your choice) of any Y-Sensor Applicators
8793-24	**Y-24 Plan** The Plan warranty is 24 months. Includes 6 boxes (your choice) of any Y-Sensor Applicators
8793-36	**Y-36 Plan** The Plan warranty is 36 months. Includes 9 boxes (your choice) of any Y-Sensor Applicators
8744-24	**Finger-24 Plan** The Plan warranty is 24 months.
8744-36	**Finger-36 Plan** The Plan warranty is 36 months.

Y-SENSOR APPLICATORS (tapes, wraps, earclips)

8828-00	**20mm Wrap Style Taping System** (100 per box) Use on neonatal foot and hand, or on pediatric toe or finger 20mm tapes use Blue color-coded liners
8829-00	**25mm Wrap Style Taping System** (100 per box) Use on neonatal foot and hand 25mm tapes use Green color-coded liners
8831-00	**20mm Finger Style Taping System** (100 per box) Use on pediatric finger or on small adult finger 20mm tapes use Blue color-coded liners
8832-00	**25mm Finger Style Taping System** (100 per box) Use on adult finger 25mm tapes use Green color-coded liners
6929-00	**Adhesive Foam Wraps** - Large (25 per box)
6968-00	**Adhesive Foam Wraps** - Small (25 per box)
8836-00	**Non-Adhesive Foam Wraps** - Large (25 per box)
8943-00	**Non-Adhesive Foam Wraps** - Small (25 per box)
6131-50	**Ear Clips** (5 per box)
6131-25	**Ear Clips** (25 per box)
8700-00	**Adhesive Dots** (250 per box)

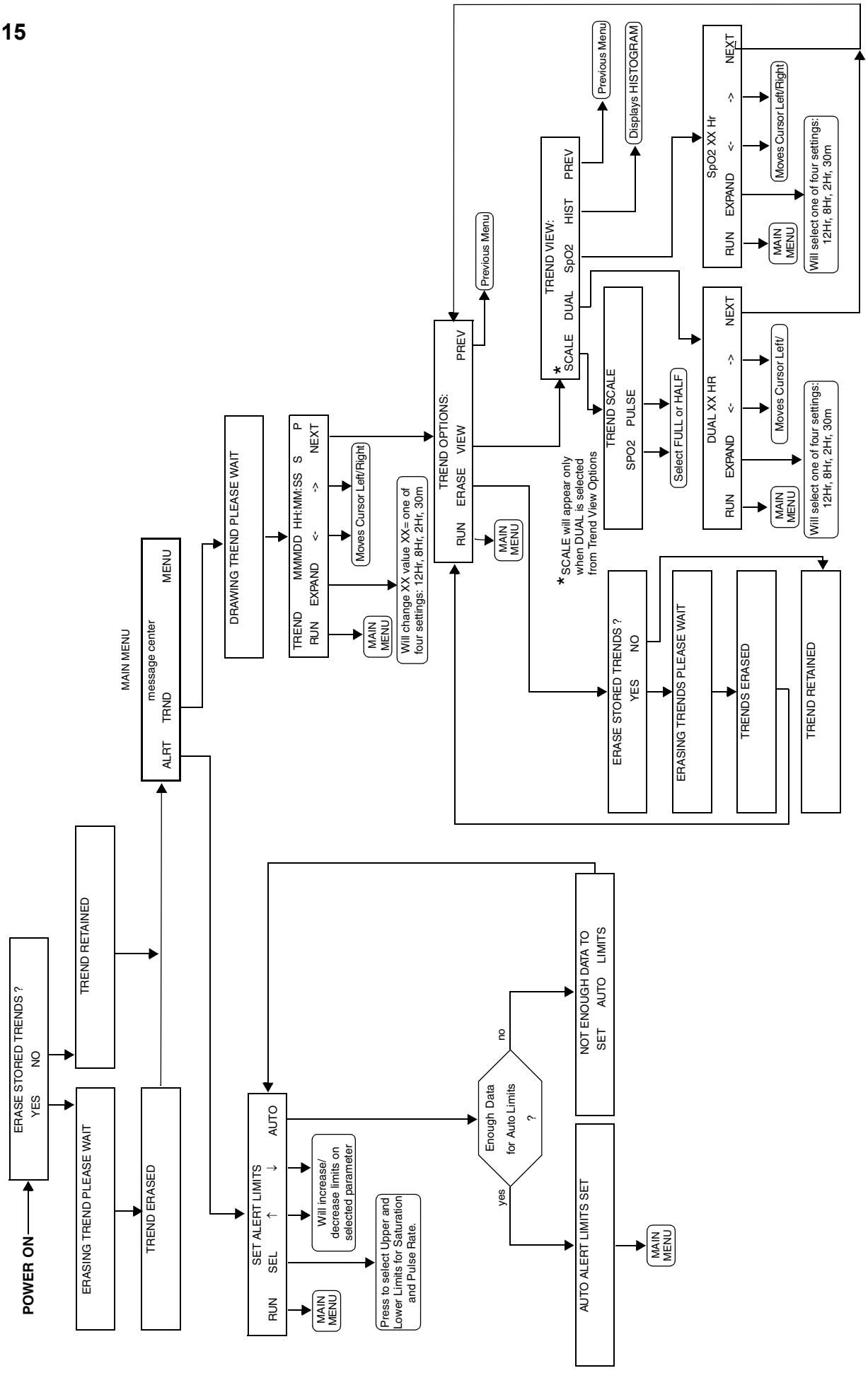
Catalog No.	Description
	PRINTERS
9140-00	**Seiko DPU-414 Thermal Printer**, with battery pack
9028-00	**Cable** to Seiko DPU-414 Printer, 9 to 15 pin, (Model 511M)
9085-00	**Cable** to Seiko DPU-414 Printer, 9 to 25 pin, (Model 515A/520A/ 860/1265/7100/2001)
9086-00	**Cable** to Seiko DPU-414 Printer, 9 to 9 pin, (Model 610)
300017	**Seiko DPU-414 Thermal Printer Paper** (5 rolls per box)
400051	**Seiko battery pack**
400052	**AC Adapter**, 120 VAC
400053	**AC Adapter**, 100 VAC
400054	**AC Adapter**, 230 VAC
	ACCESSORIES
6064-00	***NovaCARD* Startup Kit** (includes 1 each, Writer module, Reader module, SRAM Memory Card (128k), and *NovaCARD* for MS-DOS® software). *NovaCARD*—Computer Archive, Recall and Display—is a hardware/software combination that allows users to transfer patient trend data, user-stored waveforms, and monitored parameter values, from supported Novametrix monitors to a personal computer.
5962-00	***NovaCARD* Writer Module** (connects to Novametrix monitor)
6062-00	***NovaCARD* Reader Module** (includes power supply and cable to PC serial port)
6065-00	***NovaCARD* for Windows®** (3½" disk and RTU license)
6066-07	***NovaCARD* for MS-DOS®** (3½" disk and RTU license)
6068-07	**SRAM Memory Card**, 128k-byte
600048	**Cable**, connects *NovaCARD* Reader to PC (6 ft)
600049	**Cable**, PC Serial Port adapter (25-to-9 pin, 1 ft)
6064-81	***NovaCARD*** warranty extended an additional 1 year at time of purchase, hardware only, SRAM cards not included.
5693-00	**Analog Output Module**
600026	**Power Cord** (included with monitor)
7104-10	**Side Accessory Pouch**
5333-00	**Cable** for (Optional) Analog Output Module (open ended)
5334-00	**Cable** Serial Output to Personal Computer (with 25-pin connector)
5335-00	**Cable** Serial Output to Personal Computer (with 9-pin connector)
	Custom Cables—Consult factory for specifications and pricing

Catalog No.	Description
	MOUNTING SYSTEMS
140030	**Wall Mount**
140031	**Wall Mount** (less Wall Channel)
140032	**Pivot Block Mount**
140033	**Transport Mount** (without swivel head)
140034	**Transport Mount** (with swivel head)
140035	**Countertop Mount** 11 inch Base
140036	**Countertop Mount** 5 inch Base
140037	**Portable Instrument Housing**
140038	**Rollstand**
140082	**T-Mount Bracket for Rollstand**
	EXTENDED WARRANTY
	Normal warranty: Monitor—1 year, Finger Sensor—6 months
9400-81	***Model 2001*** **Pulse Oximeter - warranty extended an additional 1 year** (Total Warranty: Monitor—2 years)

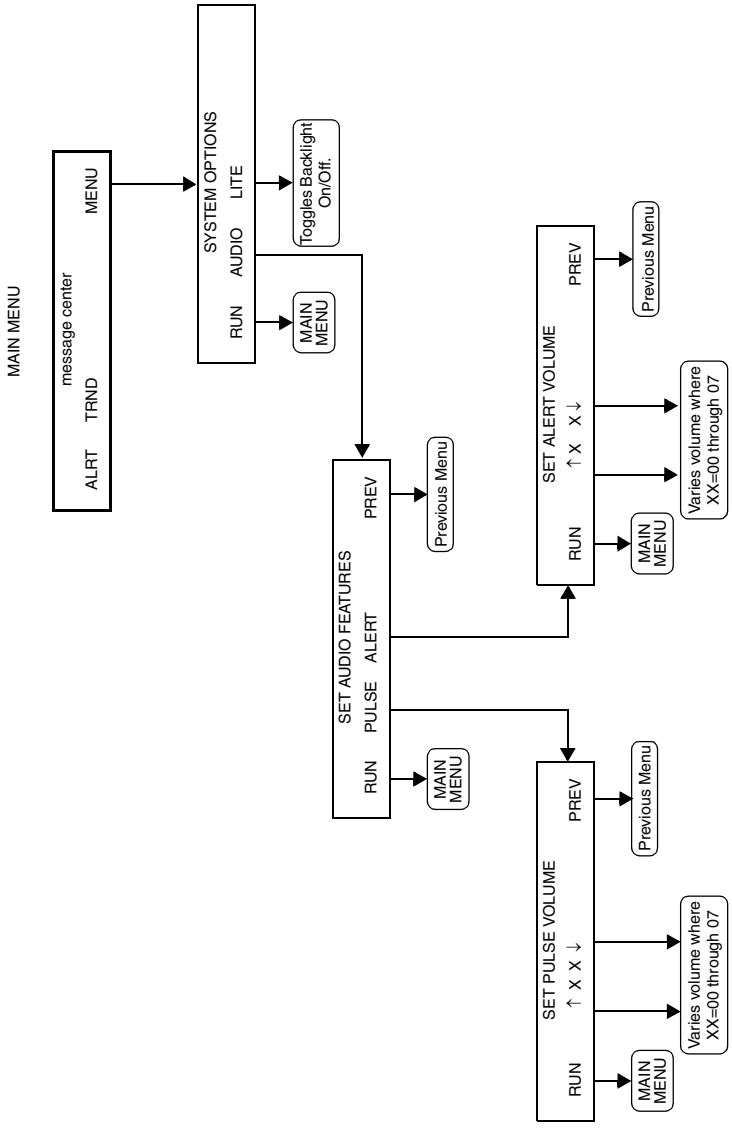
Section 15 *Menu Trees*

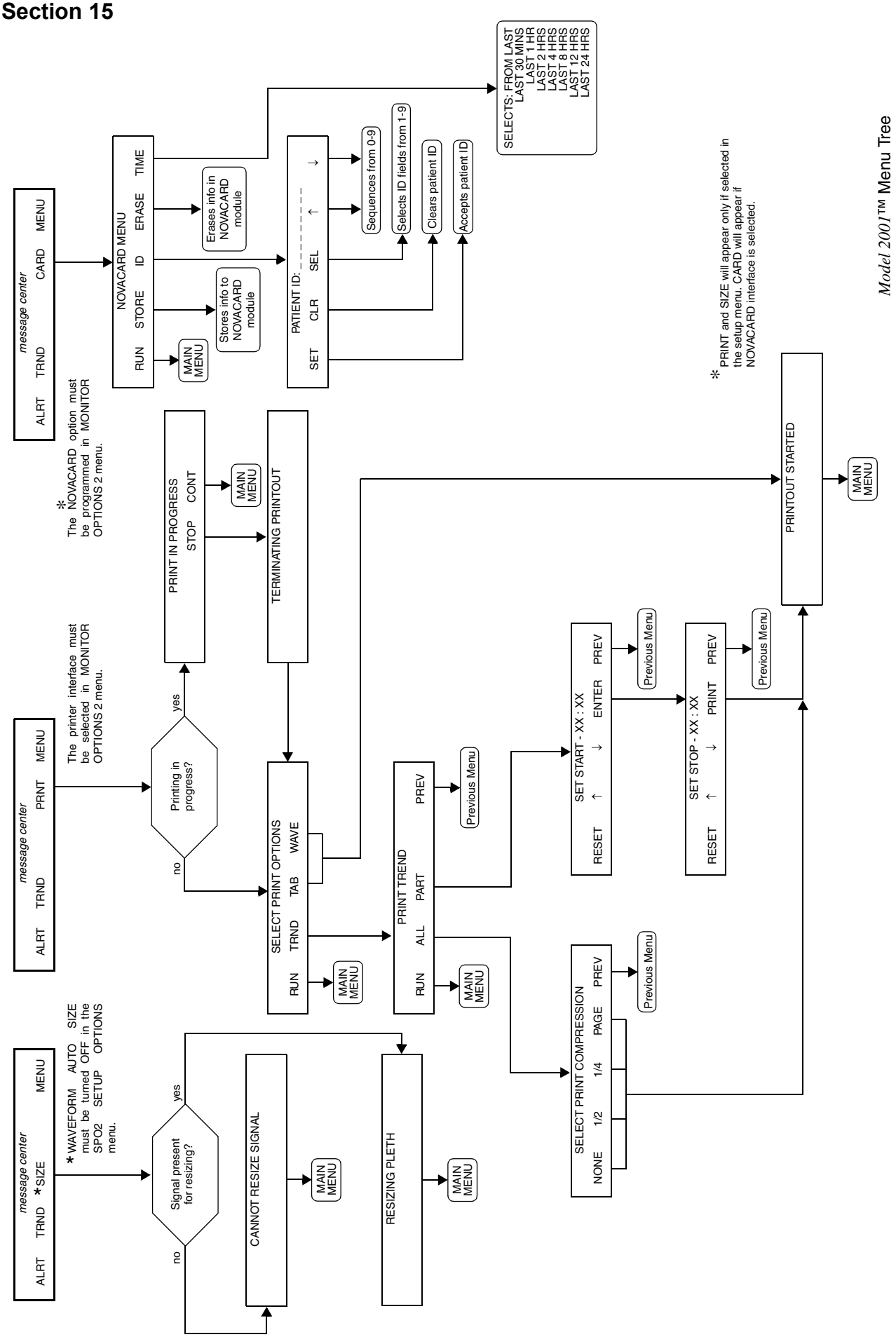
The *Model 2001* menus are described on the following pages.

Model 2001™ Menu Tree

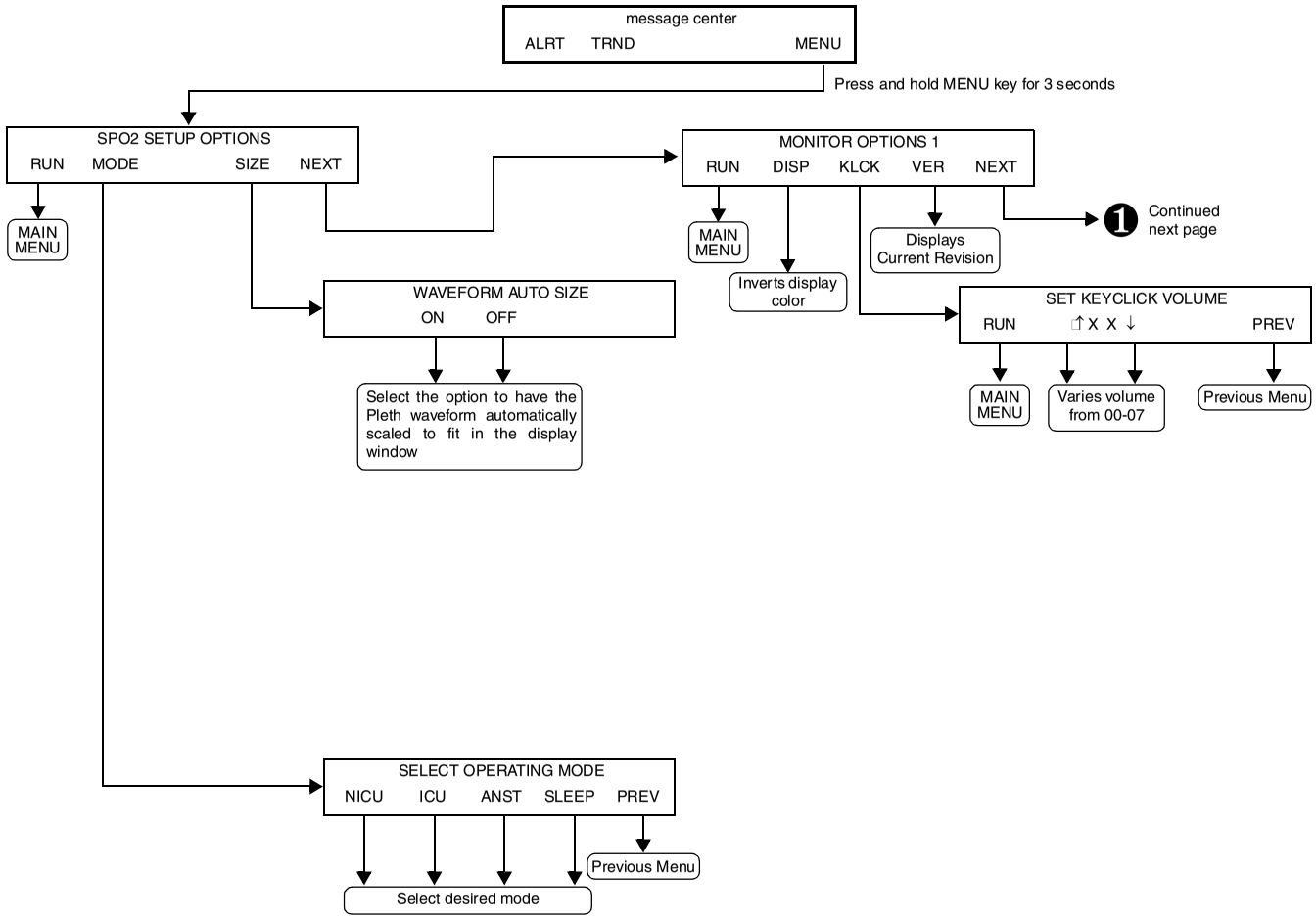


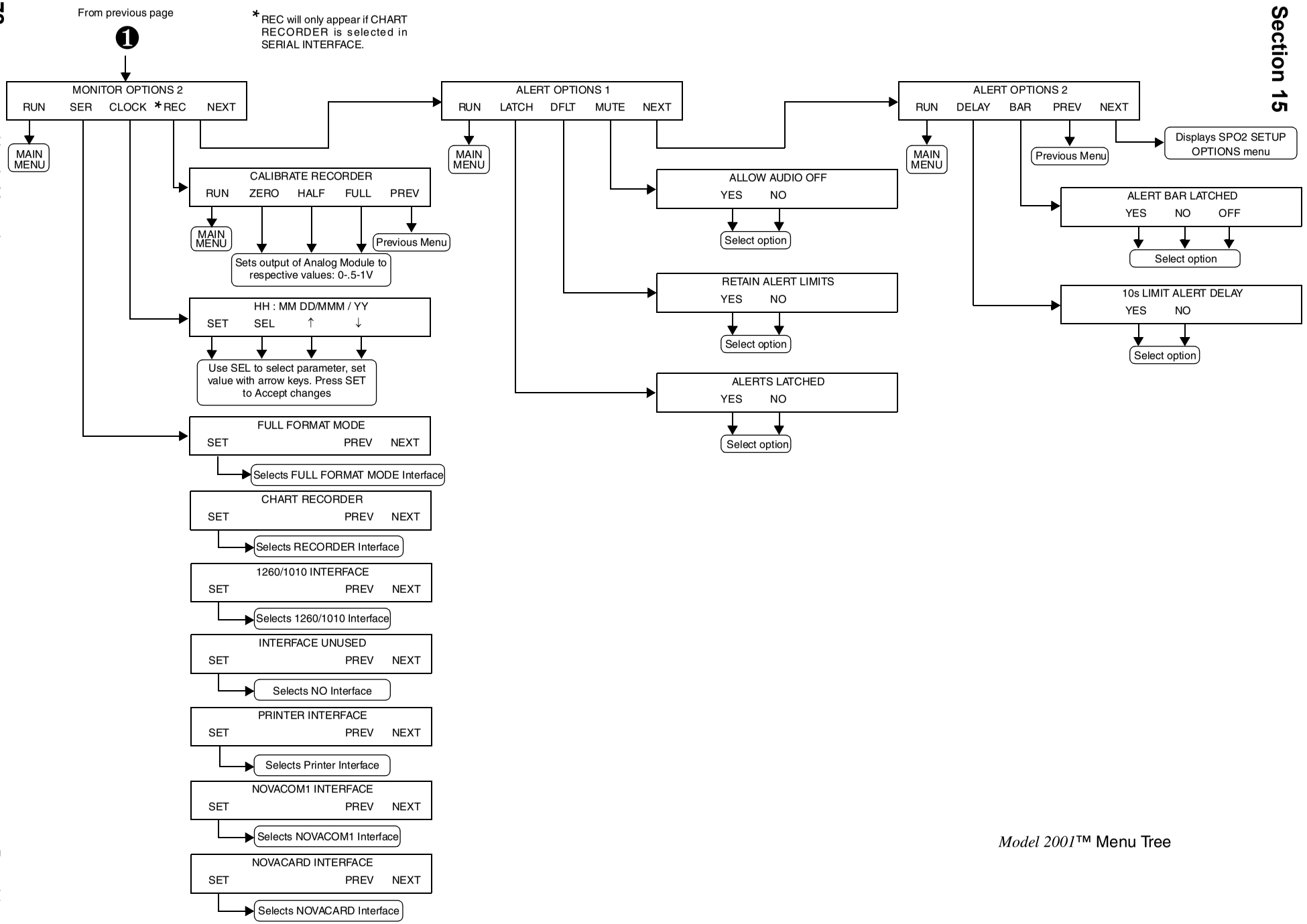
Model 2001™ Menu Tree





Model 2001™ Menu Tree


message center
ALRT TRND MENU
Press and hold MENU key for 3 seconds
SPO2 SETUP OPTIONS
RUN MODE SIZE NEXT
MAIN MENU
MONITOR OPTIONS 1
RUN DISP KLCK VER NEXT
MAIN MENU
Inverts display color
Displays Current Revision
1 Continued next page
WAVEFORM AUTO SIZE
ON OFF
Select the option to have the Pleth waveform automatically scaled to fit in the display window
SET KEYCLICK VOLUME
RUN ↑ X X ↓ PREV
MAIN MENU
Varies volume from 00-07
Previous Menu
SELECT OPERATING MODE
NICU ICU ANST SLEEP PREV
Previous Menu
Select desired mode



Model 2001™ Menu Tree